Chlorinated Substances Action Plan

Progress Report

2000

Canada

Environment Canada and Health Canada

Environnement Canada et Santé Canada

Chlorinated Substances Action Plan

Canada's Approach to Chlorinated Substances

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List of Selected Acronyms Used in This Report

ARET	Accelerated Reduction/Elimination of Toxics program
C4	Canadian Chlorine Coordinating Committee
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation under NAFTA
CEPA	*Canadian Environmental Protection Act*
CEPA 1999	*Canadian Environmental Protection Act, 1999* (renewed Act which came into effect March 31,2000)
CFCs	chlorofluorocarbons (ozone-depleting substances)
COA	Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem
CSAP	Chlorinated Substances Action Plan
CVMA	Canadian Vehicle Manufacturers' Association
CWS	Canada-wide Standards
DDT	dichlorodiphenyl trichloroethane (a pesticide)
DDE, DDD	breakdown products of DDT
HCFCs	hydrochlorofluorocarbons (ozone-depleting substances)
ISO	International Organization for Standardization
MOE	Ontario Ministry of the Environment
MOU	Memorandum of Understanding
NAFTA	North American Free Trade Agreement
NOx/VOC	nitrogen oxides/volatile organic compounds (smog precursors)
NPRI	National Pollutant Release Inventory
OECD	Organization for Economic Co-operation and Development
PBT	persistent bioaccumulative toxic
PCBs	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran
PMTS	Policy for Management of Toxic Substances (under the CCME)
POPs	persistent organic pollutants
SOP	Strategic Options Process
TSMP	Toxic Substances Management Policy
UN/ECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme

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Executive Summary

Risk management of chlorinated substances which are harmful to human health and the environment is a challenging issue. Canada's approach to the management of toxic chlorinated substances is outlined in the Chlorinated Substances Action Plan (CSAP). This approach is based on the scientific community's conclusion that current evidence does not support a complete ban on all uses and releases of chlorine and chlorinated substances. However, there is scientific evidence that the use or release of certain toxic chlorinated substances should be virtually eliminated or significantly reduced. Simply put, the approach is to "prune the chlorine-use tree, not cut it down".

Persistent, bioaccumulative and toxic chlorinated substances represent a serious threat to human health and the environment. These substances require immediate and aggressive action to achieve virtual elimination of their release to the environment. Other toxic chlorinated substances are being managed throughout their life cycles to prevent or minimize their release.

Pollution prevention is at the core of the CSAP. It has long been recognized that avoiding the creation of pollution, rather than having to clean it up after it has been created, is a far more sustainable way of doing business. Pollution prevention as the priority approach to environmental protection is entrenched in the new *Canadian Environmental Protection Act 1999* (CEPA 1999), which came into force on March 31, 2000.

The Chlorinated Substances Action Plan is part of an overall federal strategy to protect human health and the environment from the effects of toxic substances. This science-based action plan includes both regulatory and non-regulatory measures targeting chlorinated substances of concern. It is an important component of Canada's domestic and international efforts to address those substances that threaten our health and the environment.

The CSAP has five components. What follows are examples of the progress that has been achieved in each component of the Plan.

Targeting critical uses and products

Regulatory actions taken in the past are now showing results. For example, the Pulp and Paper Effluent Regulations (1992) under the *Fisheries Act* have reduced releases of chlorinated dioxins and furans from that source by more than 98 per cent. As a result, many commercial fisheries previously closed because of dioxin contamination in coastal British Columbia are now reopened.

A number of other regulations under the *Canadian Environmental Protection Act* (CEPA) have targeted chlorinated substances. There are bans or phase-outs under way in Canada for carbon tetrachloride (1995), methyl

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Targeting critical uses and products

Regulatory actions taken in the past are now showing results. For example, the Pulp and Paper Effluent Regulations (1992) under the *Fisheries Act* have reduced releases of chlorinated dioxins and furans from that source by more than 95 per cent. As a result, many commercial fisheries previously closed because of dioxin contamination in coastal British Columbia are now reopened.

A number of other regulations under the *Canadian Environmental Protection Act* (CEPA) have targeted chlorinated substances. There are bans or phase-outs under way in Canada for carbon tetrachloride (1993), methyl

chloroform (1996), chloromethyl methyl ether and bis(chloromethyl)ether (1996) and chlorofluorcarbons (1993/1996).

In 1998, 12 chlorinated substances were confirmed as Track 1 substances under the federal Toxic Substances Management Policy. Track 1 substances are persistent, bioaccumulative, toxic (PBT) and predominantly released from human activities and are slated for virtual elimination.

Regulations which are now being developed under CEPA 1999 will lead to significant reductions in releases of trichloroethylene, tetrachloroethylene and dichloromethane.

Regulatory actions are also being complemented by non-regulatory initiatives, such as the Accelerated Reduction/Elimination of Toxics (ARET) program. A number of formal environmental agreements and memoranda of understanding with industries such as automotive and auto parts manufacturing, printing and graphics, and dry cleaning have also resulted in significant reductions of a number of toxic chlorinated substances.

Improving scientific understanding

Extensive studies are being conducted to monitor and increase the understanding of the effects of chlorinated substances on wildlife. Collaborative studies among universities, industry and federal departments are investigating concerns ranging from liver and endocrine disruption in polar bears, to infertility and deformity rates in Great Lakes ring-billed gulls.

Our understanding of the impacts of chlorinated substances on health and the environment is also being improved as a result of environmental effects monitoring of pulp and paper effluents and other scientific studies. These include: research on dioxin and furan emissions from power boilers on the West Coast; organochlorines in organisms and sediment; atmospheric transport; deposition and accumulation of persistent chlorinated substances; chlorinated substances in the Great Lakes; and sources and effects of endocrine modulating substances.

Studying public health and socio-economic effects

Various studies are under way to explore the health, social and economic implications of chlorinated substances and their alternatives. Health Canada is measuring the levels and effects of chlorinated substances in foods and human tissue through a number of health assessment and human exposure studies. The results will help to identify high-risk population groups and to develop effective measures for health protection and risk reduction.

Socio-economic analyses are also being conducted on the use of chlorinated substances and alternatives. The results will assist in the decision-making process when measures are proposed to control the use and release of chlorinated substances.

Better informing the Canadian public

Canadians are able to get valuable information on the extent and location of the releases of many chlorinated substances through the National Pollutant Release Inventory (NPRI). Emitters of the 35 chlorinated substances listed on the NPRI are required to report their releases annually. In 1997, some 190 facilities reported releases of chlorinated substances to the NPRI.

The Internet is an excellent source of information on impacts of chlorine and chlorinated substances on human health and the environment. The CSAP, NPRI reports and database, the State of the Environment Report and ARET reports are some of the resources available on Environment Canada's Green Lane at http://www.ec.gc.ca. Additional information on the human health implications

of chlorinated substances is available on Health Canada's Internet site at http://www.hc-sc.gc.ca.

Promoting and leading international efforts

Canada promotes and leads international efforts to curtail the use and release of harmful toxic substances, and to encourage precaution in the use of chlorine-containing compounds. An Environment Canada official was elected to chair the International Negotiating Committee under the United Nations Economic Commission for Europe Convention on Long-Range Transboundary Air Pollution. The Committee's task is to develop a protocol to control the release and transport of persistent organic pollutants.

Canada and the United States have endorsed a binational toxics strategy that seeks to protect and ensure the health and integrity of the Great Lakes ecosystem. Eleven persistent, bioaccumulative and toxic chlorinated substances are targeted for virtual elimination under the strategy.

Chlorinated substances are also addressed by a number of other international initiatives in which Canada is an active participant. These include: the United Nations Environmental Programme; the Global Program of Action for the Protection of the Marine Environment from Land-Based Activities; and the Arctic Monitoring and Assessment Program under the Arctic Council.

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Introduction

Canada's approach to chlorinated substances

The federal Toxic Substances Management Policy (TSMP) released in June 1995 calls for the virtual elimination from the environment of all toxic, persistent, bioaccumulative substances that result from human activity. The Policy also calls for complete life cycle management of all other substances of concern that are released to the environment.

Within the framework of this science-based policy, the Chlorinated Substances Action Plan (CSAP) was developed to manage chlorinated substances which are toxic and of the greatest concern to human health and the environment. This report summarizes the results and progress achieved in the five years since the plan was announced in October 1994.

"Pruning" The Chlorine-Use Tree

Progress through cooperation

Significant progress under the CSAP has been achieved as a result of cooperation and partnership among federal and provincial governments, industry, scientists, universities and other stakeholders. The CSAP encompasses the full spectrum of Canada's economy and geography, and has attracted international attention. The initiatives described in this report are an illustration of the positive change that is possible through multi-stakeholder cooperation and effort.

Canada's approach to chlorinated substances

Canada is committed to a healthy environment and a prosperous economy. Part of that commitment are a wide variety of efforts, both at home and with other countries, to address the chlorinated substances that pose a threat to human health and the environment.

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"Pruning" The Chlorine-Use Tree

The CSAP targets the most harmful chlorinated substances for virtual elimination or significant reduction from the environment. Measures are under way to achieve these goals and in many cases, the targets have been reached.

Current scientific opinion, including findings of the International Society of Environmental Toxicology and Chemistry, holds that a complete ban on all chlorine uses cannot be supported by the present scientific evidence. On the other hand, there is conclusive evidence that a number of highly toxic chlorinated substances should be eliminated. The CSAP reflects these findings by moving aggressively to cut harmful uses and releases of chlorinated substances.

The Action Plan

The CSAP is a five-part approach to eliminating or significantly reducing toxic chlorinated substances within a set timetable using both regulatory and non-regulatory instruments. The approach includes:

1. **Targeting critical uses and products by:**

   (i) virtually eliminating those chlorinated substances that are persistent, bioaccumulative and toxic;

   (ii) taking a sectoral and/or life cycle approach to the management of other toxic chlorinated substances; and

   (iii) entering into environmental performance agreements with key industrial sectors representing the largest sources of releases of targeted chlorinated toxic substances.

2. **Improving scientific understanding** of chlorinated substances and their impacts on human health and the environment.

3. **Studying public health and socio-economic effects** of chlorinated substances and their alternatives.

4. **Better informing the Canadian public** about chlorine and chlorine-related issues.

5. **Promoting and leading international efforts** for global action on chlorinated substances by the international community.

Each of these five parts is presented in detail in this report. In the Appendices, there are lists of chlorinated substances covered by various environmental and health protection programs, and a chart that shows how these programs relate to each other. As well, there is a summary report provided to Environment Canada on initiatives and results from a variety of programs and studies carried out by the Canadian Chlorine Coordinating Committee, known as C4. This organization includes seven industry associations and 23 companies. C4 supports the CSAP and its comprehensive approach to the management of chlorinated substances.

Looking to The Future

The CSAP builds on accomplishments achieved to date to virtually eliminate persistent, bioaccumulative and toxic chlorinated substances, and to significantly reduce the release of other toxic chlorinated substances. Significant reductions have been achieved through efforts by industry, governments and other organizations as part of their commitment to act on these substances. Although much has been achieved, there is still work to be done to address issues related to chlorinated substances that continue to pose unacceptable risks to human health and the environment.

The federal government and its partners will continue to aggressively implement new and established initiatives under the CSAP to ensure that Canadians continue to enjoy a clean and healthy environment.

Public involvement can also help achieve significant progress in the reduction of harmful uses and releases of chlorinated substances. For instance, consumer choices can be influenced by knowledge of the potential effects of toxic chlorinated substances on human health and the environment. In turn, consumers have the ability to influence the design and make-up of products that they purchase. Environment Canada and Health Canada will continue to raise the awareness of Canadians about toxic chlorinated substances by providing timely information. These efforts will enable Canadians to make choices that will help minimize, reduce or prevent adverse impacts on human health and on the environment.

Part 1 - Targeting Critical Uses and Products

There are a number of initiatives targeting critical chlorinated substance uses and products that have either been completed or are in progress.

Completed Targeted Actions

Carbon tetrachloride

Ozone-depleting substance, primarily used as a feedstock for the production of chlorofluorocarbons.

Production and importation were phased out in January 1995 under the Ozone-depleting Substances Regulations of the *Canadian Environmental Protection Act* (CEPA), except for use as a feedstock and for explosion suppression and laboratory applications. These are permitted under the Montreal Protocol.

1,1,1-trichloroethane ["methyl chloroform"]

Ozone-depleting substance; primarily used as a degreasing solvent.

Production and importation were phased out in January 1996 under the CEPA Ozone-depleting Substances Regulations, except for certain laboratory uses permitted under the Montreal Protocol.

The Montreal Protocol

On September 16, 1987 the *Montreal Protocol on Substances that Deplete the Ozone Layer* was signed by 24 countries in Montreal, Quebec. The Protocol established measures for controlling the production and consumption of ozone-depleting substances (ODS). Two amendments have been made to the original protocol, and it currently provides targets and schedules for reduction and/or phase-out of chlorinated ODS such as CFCs, HCFCs, 1,1,1-trichloroethane (methyl chloroform), and carbon tetrachloride. As of March 29, 2000, the Montreal Protocol had been ratified by 173 countries.

Chloromethyl methyl ether and bis(chloromethyl)ether

Used as water repellents and in the manufacture of polymers.

These substances were assessed and declared toxic under CEPA. They are not manufactured, imported or used in Canada. As a precautionary pollution prevention measure, effective April 30, 1996, the manufacture, importation and use of these substances in Canada was banned under the Prohibition of Certain Toxic Substances Regulations under CEPA.

Chlorofluorocarbons

Ozone-depleting substances.

Production in Canada of these ozone-depleting substances ceased in 1993. As of January 1996, importation was phased out under the CEPA Ozone-depleting Substances Regulations, except for use in metered-dose inhalers (such as those used for treating asthma), and for certain laboratory uses permitted by the Montreal Protocol. As of January 1999, importation of recovered or recycled chlorofluorocarbons (CFCs) is only allowed if they are reclaimed in Canada and then exported back to the country of origin.

Actions in Progress

The Toxic Substances Management Policy

The Toxic Substances Management Policy (TSMP) commits the federal government to identifying persistent bioaccumulative toxic substances that result primarily from human activities (referred to as Track 1 substances under the TSMP), and ensuring that they are virtually eliminated from the environment. In March 1997, as part of this commitment, Environment Canada identified 13 highly chlorinated candidate substances. On July 4, 1998, after public consultation and careful consideration of scientific evidence, Environment Canada confirmed 12 of these as Track 1 substances through publication in the Canada Gazette. They are: PCBs; polychlorinated dibenzo-p-dioxins; polychlorinated dibenzofurans; hexachlorobenzene; aldrin; dieldrin; chlordane; DDT; endrin; heptachlor; mirex; and toxaphene. The status of the thirteenth candidate, short-chain chlorinated paraffins, remains under scientific consideration.

Virtual elimination of these substances will be achieved through strategies that consider whether they are commercial products, by-products, contaminants, wastes, or substances present at contaminated sites.

Toxic substances that do not satisfy all four criteria of Track 1 substances are candidates for full life-cycle management to prevent or minimize their release into the environment. Pollution prevention, pollution control, remediation or international action may be used to achieve the objective set for Track 2 substances. However, pollution prevention is often the most cost-effective management strategy and in such cases is identified by the federal government as the preferred approach.

For additional information on the TSMP and its implementation, see http://www.ec.gc.ca/cceb1/eng/tsmp.htm

The Toxic Substances Management Policy (TSMP) outlines the federal government's approach to the management of toxic substances. It was developed to strengthen the protection of human health and the environment, and to provide guidance and a consistent approach to the assessment and management of substances by the federal government. Two key objectives form its management framework: virtual elimination from the environment of toxic substances that are persistent, bioaccumulative, and primarily the result of human activity (Track 1); and life-cycle management of other toxic substances and substances of concern to prevent or minimize their releases into the environment (Track 2). The federal government is committed to identify candidate substances for virtual elimination from the environment, and to consult the public in the management of these substances. The federal government will engage those stakeholders involved in the generation, release or use of confirmed Track 1 substances in order to propose and implement domestic and international actions to protect the health of Canadians and the environment.

Reaffirming the federal/provincial/ territorial approach to the management of toxic substances, the Canadian Council of Ministers of the Environment (CCME) has adopted the same criteria for the selection of Track 1 substances under its Policy for the Management of Toxic Substances (PMTS). The CCME PMTS was endorsed by all CCME Ministers in January 1998.

Implementation of the Plan

Part 1 - Targeting Critical Uses and Products

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Actions in Progress

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Polychlorinated dibenzo-p-dioxins and dibenzofurans [PCDDs and PCDFs]

Highly persistent and toxic compounds from industrial and natural sources

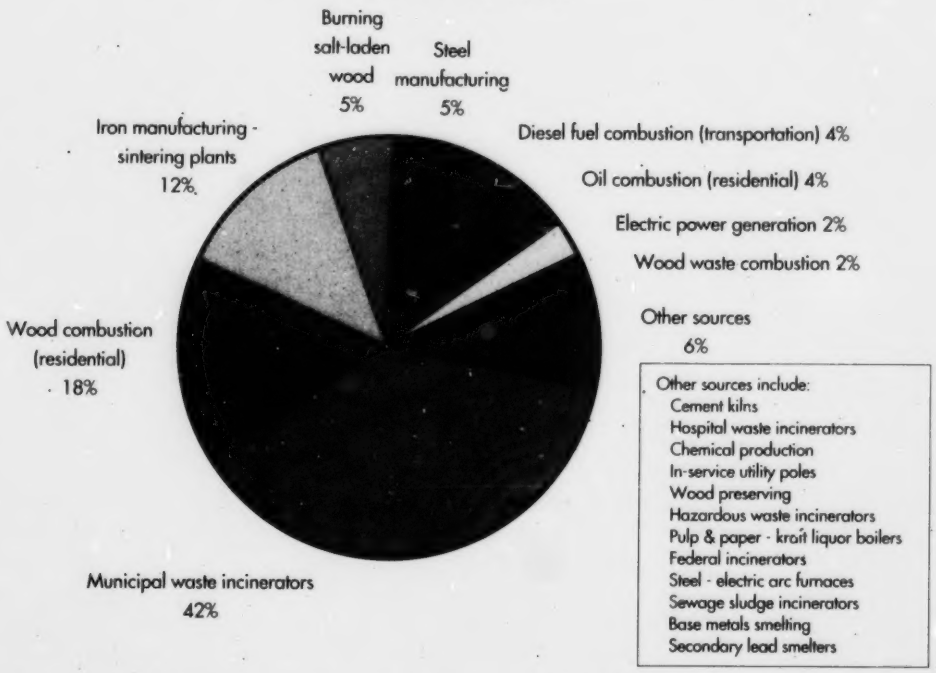
Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) enter the environment as complex mixtures. Sources of atmospheric releases include incineration, steel manufacturing, wood combustion and other industrial operations (see Figure 1). Historically, pulp and paper mills using chlorine bleaching were a major source of water releases of PCDDs and PCDFs.

Assessed and declared toxic under CEPA, these substances also meet the criteria for Track 1 (persistent, bioaccumulative and toxic) substances under the TSMP and are therefore targeted for virtual elimination. A federal/provincial task force was established to develop an action plan consistent with the TSMP goal of virtual elimination. An inventory of sources and releases of chlorinated dioxins and furans was presented in 1998 to the Federal-Provincial Advisory Committee established under CEPA. This report is now publicly available on the Internet at: http://www.ec.gc.ca/dioxin/index.htm.

Some of the results and recommendations of the dioxin and furans release inventory report are:

- Water releases – Between 1990 and 1997, a 99 per cent reduction in water releases was achieved, mainly as a result of the adoption and implementation of pulp and paper regulations under CEPA. Water releases from the pulp and paper sector have generally been reduced to below the "measurable concentration" level, which is consistent with the objective of virtual elimination. The report concludes that for the pulp and paper sector, no additional reductions in water releases are required.

Figure 1
Estimated PCDDs/PCDFs Atmospheric Releases in 1999
(Total: 200 g TEQ/y)



Graph source: Dioxins and Furans and Hexachlorobenzene: Inventory of Sources, Environment Canada (1999)

- Atmospheric releases – Between 1990 and 1997, an 18-per cent reduction in atmospheric releases was observed. By 1999, it is projected that an additional 25-per cent reduction will have been achieved as a result of announced upgrades or closures of industrial facilities, for a total reduction of 43 per cent from the 1990 base year. Atmospheric releases of PCDDs and PCDFs in 1999 are expected to have been approximately 200g total equivalence units (TEQ). The report recommends that through the federal/provincial Harmonization Accord, a number of priority sectors be identified for Canada-wide Standards. Prevention and/or reduction measures consistent with the objective of virtual elimination should then be developed for these sectors.

The data and recommendations contained in the inventory report assisted in the identification of priority sectors for action during the development of CCME Canada-wide Standards (CWS). Priority sources were identified including conical burners, residential wood combustion, combustion of salt-laden hog fuel, municipal incineration, steel manufacturing and iron sintering. Public consultations have focused on the development of targets and timelines for the virtual elimination of dioxin/furan sources and releases. Additional information is available on the Internet at the CCME website on CWS for dioxins at: http://www.mbnet.mb.ca /ccme/3e_priorities /3ea_harmonization/3ea2_cws/ 3ea2i_overviews /3ea2i2.html.

Since 1992, stringent federal Pulp and Paper Effluent Regulations developed under CEPA have addressed chlorinated dioxin and furan releases in effluents from pulp and paper mills using a chlorine bleaching process. Among the requirements, chemical pulp mills using a chlorine bleaching process are prohibited from releasing measurable concentrations of chlorinated dioxins and furans in their effluent. As a result, many mills changed processes and raw materials to greatly reduce the level of chlorinated dioxins and furans formed during pulp and paper manufacture. Releases of dioxins and furans from pulp and paper mills are down by more than 99 per cent – from 450 grams per year (expressed in toxic equivalence units) in 1988 to approximately three grams per year in 1997.

Contamination of fisheries by dioxin/furan releases in pulp mill effluents has been reduced to very low levels and significant environmental improvements have been achieved. The state of fisheries has improved as a result, as seen in the reopening of approximately 46 per cent of British Columbia's commercial shellfish fisheries previously closed because of dioxin/furan contamination. As levels of contamination decrease, it is expected that additional sites will be reopened.

Polychlorinated biphenyls

Present in oil used in some older electrical transformers and capacitors.

Polychlorinated biphenyls (PCBs) are synthetic chemical compounds, of which many are highly chlorinated. First used in 1929 because fire-resistant and insulating properties made them ideal for use as cooling and insulating fluids in industrial transformers and capacitors, PCBs were also used in hydraulic and heat transfer systems, and in products such as plasticizers, rubbers, inks, paints, waxes, and older model fluorescent light fixtures. PCBs are no longer produced or imported into Canada. They are still in use in several products, with the majority contained in electrical transformers and capacitors.

As early as 1973, Canada joined with the Organization for Economic Co-operation and Development (OECD) to minimize the discharge of PCBs to the environment because of their impacts on human health and the environment. The Chlorobiphenyl Regulations No. 1, No. 2 and No. 3 were passed between 1977 and 1985, restricting the use of PCBs in Canada. Also in 1985, the CCME adopted a PCB Action Plan that resulted in three national guidelines on PCB management, treatment and disposal, as well as a federal/provincial/territorial co-ordinated approach to dealing with issues arising from the removal of PCBs from the Canadian environment. In 1991, Chlorobiphenyl Regulations were revised and published under CEPA to restrict the use and release of PCBs.

In 1988, the PCB Interim Order and Subsequent Regulations were passed under CEPA to ensure proper management of PCBs during storage. A federal Mobile PCB Treatment and Destruction Regulation was also passed in 1990 to ensure proper destruction of federal PCBs. A PCB Export Ban was also passed in 1990 to ensure that destruction occurred within Canada. Finally, PCBs were confirmed as Track 1 substances in 1998 under the TSMP and the federal/provincial/territorial CCME Policy for Management of Toxic Substances (PMTS) program, and are therefore slated for virtual elimination from the environment.

Internationally, phase-out targets for PCBs have been adopted by the United Nations Economic Commission for Europe (UN/ECE) and the Commission for Environmental Co-operation (CEC) under the North American Free Trade Agreement. Canada has signed the UN/ECE initiative, agreeing to "make a determined effort" to eliminate the use of PCBs in transformers and capacitors by 2010 and destroy them by 2015. The goal of the CEC is to eliminate the use of PCBs at sensitive sites by the end of 2000 and in transformers and capacitors by 2008, and to restrict the amount of time that PCB wastes can be stored.

Environment Canada, in consultation with the provinces/territories and major stakeholders, will amend existing PCB regulations to phase out the use of PCBs in Canada by 2008, and prohibit storage beyond 2010, requiring destruction by 2010. Environment Canada will also produce federal regulations to virtually eliminate the emission of PCBs from treatment and destruction equipment operating on federal lands. Similar restrictions will be negotiated with the provinces and territories. The negotiated emission levels and time frames will facilitate compliance with Canadian and international objectives.

Short-chain chlorinated paraffins

Primarily used in metal working oil and as plasticizers for making flexible polyvinyl chlorides (PVCs).

Assessed and declared toxic under CEPA, short-chain chlorinated paraffins (SCCPs) were initially proposed as Track 1 candidates under the TSMP. A multi-stakeholder consultation process to identify control options for SCCPs was initiated, and potential options and targets for reducing and eliminating SCCP use were identified for various industrial sectors. However, the consultation process was suspended in 1997 as new information was introduced on the persistence and bioaccumulation of SCCPs. The consultation process will resume as soon as the new information is fully assessed.

Hexachlorobenzene

Generated in industrial processes such as manganese smelting, and as a by-product and/or impurity from incineration and the production and use of some pesticides and solvents.

Hexachlorobenzene (HCB) is a confirmed Track 1 substance under the TSMP, and is therefore targeted for virtual elimination from the environment. Regulations are being developed by Environment Canada to virtually eliminate HCB, and the Department is working with concerned stakeholders to develop control options for HCB released as a by-product of certain processes.

Although the manufacture of HCB has ceased in Canada and most other countries, regulations are being developed as a precaution to prohibit the manufacture, import, export, processing and sale of HCB. Regulations are expected in 2000.

HCB is currently released during the incineration of chlorine-containing material, the preservation of wood, and the use of some chlorinated pesticides and solvents. During incineration, HCB is generated under the same conditions as those allowing formation of chlorinated dioxins and furans. Since it is being released in many instances from the same sources as dioxins and furans, releases of HCB are being addressed through the implementation of measures to prevent, reduce or eliminate the release of chlorinated dioxins and furans (see the Polychlorinated Dibenzodioxins and Dibenzofurans section in this chapter).

The implementation of the recommendations of the Strategic Options Process (SOP) for Wood Preservation (see the Wood Preservation section in this chapter) will also serve to reduce emissions of HCB from such facilities. In addition, Environment Canada is of the opinion that current actions by the degreasing and dry cleaning sectors (see the Trichloroethylene and Tetrachloroethylene section in this chapter) will result in reductions of HCB releases from the use of chlorinated solvents.

Wood Preservation

Environment Canada published in March 1999 a revised and updated version of the Technical Recommendations Document (TRD) for wood preservation facilities, providing best practice guidance to ensure that wood preservation is done in an environmentally responsible manner. The TRD formed the basis for recommendations developed under the Strategic Options Process (SOP) for wood preservation. The SOP has been completed, and the implementation of the SOP recommendations will result in reductions of release of toxic chlorinated substances from wood preservation facilities.

For additional information on the wood preservation SOP, please see http://www.ec.gc.ca/sop/english/wp.htm.

Hydrochlorofluorocarbons

Ozone-depleting substances used as transitional chemicals to replace CFCs

In January 1996, consumption of hydrochlorofluorocarbons (HCFCs) was frozen at a base level equivalent to 887 ozone-depleting potential (ODP) tonnes under the CEPA Ozone-depleting Substances Regulations. HCFCs are scheduled for 35-per cent reduction from base level by January 2004, 65 per cent by January 2010, and 90 per cent by January 2015. There is to be a complete phase-out by January 2020, except for a small quantity of HCFC-123 (maximum 4.5 ODP tonnes) that will be allowed for use in the servicing of existing equipment. In addition, where alternatives exist, the use of HCFCs is currently being eliminated.

Trichloroethylene and Tetrachloroethylene ["perchloroethylene"]

Primarily used as degreasing and cleaning solvents.

Trichloroethylene (TCE) is used as a degreasing solvent. Tetrachloroethylene (PERC) is used as a cleaning solvent in the dry-cleaning industry, as a degreasing solvent, and as a feedstock for the production of HCFCs. Both TCE and PERC were assessed and declared toxic under CEPA and are managed as Track 2 substances under the TSMP.

Under the CCME NOX/VOC Management Plan and in collaboration with provincial governments and other stakeholders, Environment Canada has developed environmental Codes of Practice for dry-cleaning and degreasing facilities to prevent and minimize solvent emissions. Ontario has established regulations that require dry-cleaning operators to take a training course based on the CCME Dry-Cleaning Code of Practice. The federal government is encouraging provincial dry-cleaning associations to voluntarily develop and implement training courses for dry-cleaning operations based on the CCME Code of Practice. Other provinces are considering regulatory initiatives similar to those in Ontario.

In February 1997, following extensive consultation under the Strategic Options Process, the Ministers of Environment and of Health announced that TCE and PERC would be controlled through regulations under CEPA. Separate regulations for the dry-cleaning sector and for solvent degreasing are now being developed. The former is expected to be published in *Canada Gazette*, Part 1 in summer 2000 for public review and comments. The regulations for solvent degreasing will follow in 2001.

Dry Cleaning: A decision to regulate environmental releases resulted from information collected on the use and extent of losses of PERC in the dry-cleaning sector. As a result of the proposed regulation, the use of dry-cleaning PERC is expected to be reduced from 5.5 kilotonnes in 1994 to 2.3 kilotonnes 12 months after the promulgation of the regulation. PERC will only be allowed to be used in minimum solvent usage (third generation) dry-cleaning machines. Furthermore, a performance standard will be set for dry-cleaning machines of 10 kg of PERC per 1,000 kg of articles cleaned.

On January 1, 1998, the Quebec government imposed a levy on PERC sold to dry cleaners. The funds collected are to be applied as tax credits over a two-year period towards a portion of the purchase of new and more efficient PERC dry-cleaning machines or other state-of-the-art cleaning technologies that use water or petroleum-based solvents.

Degreasing Operations: Under the proposed CEPA 1999 regulations targeting the use of TCE and PERC in degreasing operations, a baseline consumption level is being established for degreasing operations. The average consumption for the three years from 1994 through 1996 is expected to be used as the baseline level. At the time of the implementation of the regulations, degreasing operators are expected to be required to freeze consumption at baseline levels. Three years later, the proposed regulations are expected to require the degreasing operators to reduce their TCE and PERC use by 65 per cent from baseline levels.

Dichloromethane ["methylene chloride"]

Used as a solvent in consumer and commercial paint removers and aerosols, in the manufacture of flexible polyurethane foam, adhesives, and pharmaceutical products, as a laboratory chemical, and as a general cleaning solvent.

Dichloromethane **(DCM)** was assessed as toxic under CEPA and is managed as a Track 2 substance under the TSMP. Recommendations for preventing and reducing emissions were developed through multi-stakeholder consultations. Stakeholders' recommendations are contained in the *Report on Risk Management Options for DCM* that was presented to the Ministers of Environment and of Health in 1998. The overall reduction goal for DCM identified in the report is about 3,100 tonnes, or 50 per cent by 2002 from 1995 release levels of approximately 6,500 tonnes.

During the consultations on DCM, five industry sectors committed to meet the targets and timelines set for reducing DCM releases by participating in the Accelerated Reduction/Elimination of Toxics (ARET) program. The Ministers of Health and of Environment accepted the stakeholders' recommendations on the condition that affected companies file action plans with ARET by January 31, 1999. The lack of a timely response by industry to commit to voluntary action has resulted in a decision by the Minister of the Environment to develop regulations under CEPA 1999. Regulation of DCM, expected for 2000, will ensure that the targets set out in the risk management report will be met within the original time frame.

For additional information, see the DCM risk management options report at http://www.pyr.ec.gc.ca/ep/dcm.

National Environmental Quality Guidelines for Chlorinated Substances

A number of national environmental quality guidelines have been, or are in progress, under the auspices of the CCME. (See Appendix 4 for a list of chlorinated substances to which these guidelines apply.)

- Water quality guidelines for 36 chlorinated substances have been published for the protection of freshwater life. For seven of these substances, marine water quality guidelines are also available.
- Sediment quality guidelines for 11 chlorinated substances have been published for both marine and freshwater ecosystems.
- Soil quality guidelines for five chlorinated substances have been published.
- Tissue residue guidelines for three chlorinated substances have been published to protect wildlife from the impacts of consuming polluted aquatic biota.
- Soil quality, sediment quality, and tissue residue guidelines are being developed for polychlorinated dibenzo-*p*-dioxins and dibenzofurans.

For additional information, see the Canadian Environmental Quality Guidelines website at: http://www.ec.gc.ca/ceqg-rcqe.

Chlorinated Wastewater Effluents

Chlorinated wastewater effluents from municipal wastewater treatment plants and industrial sources were assessed and declared toxic under CEPA in January 1994. The assessment of chlorinated wastewater effluents (CWWE) focused on chlorinated municipal effluents (CME). Initial discussions on the CME issue, conducted through the CEPA Federal Provincial Advisory Committee (FPAC), now called the CEPA National Advisory Committee under CEPA 1999, resulted in the presentation to FPAC of a report summarizing the CWWE issue and a proposal for a voluntary reduction scheme to phase out chlorine disinfection. This is in keeping with the current trend in provincial policies toward effluent dechlorination and the use of alternate forms of disinfection.

Currently, under CEPA's second Priority Substances List, there are two substances being assessed which are directly related to the CWWE/CME issue. If they are declared toxic, a solution which deals with the inter-relationship of the substances in the municipal effluent stream will be proposed.

At the same time, Environment Canada continues to work with the Canadian Water and Wastewater Association, as well as with the Federation of Canadian Municipalities, to develop new initiatives that deal with the issue of effluent discharges from municipalities.

Categorizing and Screening the Domestic Substances List

The *Canadian Environmental Protection Act 1999* (CEPA 1999) came into force on March 31, 2000. It requires the government to assess more substances for toxicity more quickly and sets firm deadlines for action to control toxic substances. Under CEPA 1999, a substance is "toxic" if it may have an immediate or long-term harmful effect on the environment or its biological diversity, if it may constitute a danger to the environment on which life depends, or if it may constitute a danger in Canada to human life or health.

CEPA 1999 requires the Ministers of Environment and of Health to categorize the 23,000 substances on the Domestic Substances List (DSL), of which approximately 2,000 are chlorinated. The categorization must be completed within seven years of September 14, 1999, the date on which CEPA 1999 received Royal Assent. Substances which meet the categorization criteria proceed to a screening level risk assessment to determine if they are "toxic" as defined by CEPA 1999.

A technical Advisory Group has been established to provide expert advice to Environment Canada for identifying and resolving issues of a scientific, technical and process nature that emerge from the categorization and assessment process. To date, Environment Canada and Health Canada have identified 110 organic substances representative of several chemical classes as candidates for a pilot project.

Additional information on CEPA 1999 is available from the CEPA website at http://www.ec.gc.ca/cepa.

Non-Regulatory Initiatives

Through formal environmental agreements and memoranda of understanding (MOUs), governments are pursuing non-regulatory approaches to achieve environmental protection goals. These multi-stakeholder agreements, that complement regulatory regimes, establish reduction targets and commit industry to using best efforts in the reduction or elimination of toxic substance emissions.

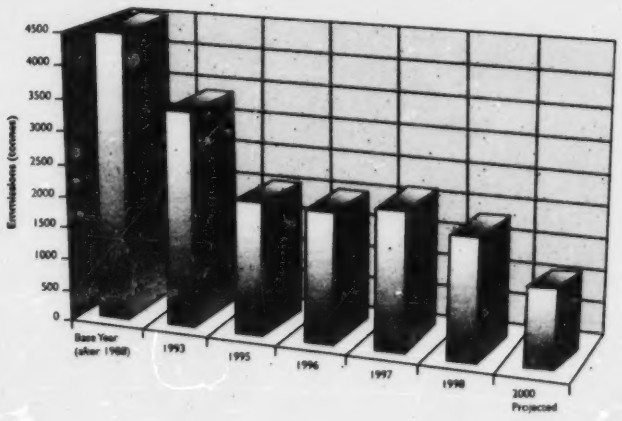
The following programs, agreements and MOUs with industrial sectors and provinces are either in place or under development and address the use and release of toxic substances, including some chlorinated substances.

The Accelerated Reduction/Elimination of Toxics Program

The Accelerated Reduction/Elimination of Toxics (ARET) Program is a multi-stakeholder initiative aimed at reducing the potential adverse effects of toxic substances on human health and the environment by accelerating the reduction or elimination of toxic substance emissions. Under the ARET Program, targets are set for voluntary action on 117 toxic substances, 33 of which are chlorinated compounds (see Appendix 2).

Nine of the 33 chlorinated substances in ARET are persistent bioaccumulative toxic (PBT) substances. For these substances, the reduction target is 90 per cent by 2000 from base-year levels, and the long-term goal is their virtual elimination. For other ARET substances, the reduction target from base-year levels is 50 per cent by 2000, and the vision is to reduce their emissions to levels insufficient to cause harm.

Figure 2
ARET Actual and Projected Emissions of Chlorinated Substances



Graph source: ARET Secretariat

In response to the ARET challenge launched in early 1994, 169 organizations from nine major industrial sectors and four government departments have submitted action plans to reduce emissions of ARET substances. From the base year (a base year after 1987 was chosen by participants as the date from which their reductions will take place) to 1998, emissions of PBT chlorinated substances from ARET's List A-1 were reduced by 636 kg, or 99 per cent. A 60 per cent or almost 2,686,000 kg reduction was achieved for other chlorinated substances targeted under ARET. According to participants' action plans, an additional reduction of over 831,000 kg (47 per cent) of chlorinated substance emissions is expected by 2000 from 1998 levels. (See Appendix 2 for a table listing reported emissions of ARET substances.)

More information is available on the ARET Internet site at http://www.ec.gc.ca/aret/.

The Canada-Ontario Agreement

Ten 'Tier I' chlorinated substances are targeted for virtual elimination under the Canada-Ontario Agreement (COA) respecting the Great Lakes Basin Ecosystem. Five 'Tier II' chlorinated substances are targeted for significant reduction. The COA substances are listed in Appendix 1.

The following are some of COA's targets and schedules and progress achieved to date relating to chlorinated substances:

- *"Confirm by January 1996, that zero discharge within the basin for 'Tier I' chlorinated substances has been achieved."*
  - ▲ A comprehensive review of five banned pesticides was completed (aldrin/dieldrin, chlordane, DDT, mirex and toxaphene). These pesticides are no longer used in Ontario, however old stock may still be retained inadvertently as household hazardous waste. A fact sheet on the priority pesticides has been prepared and is included in the federal and provincial Pesticides Use Survey, Ontario's Vendors and Growers Certification Program, the Ontario Ministry of the Environment (MOE) pesticide licensing re-application packages, and the MOE's Pesticides Licensing System Training Program. The fact sheet will assist householders to identify and safely dispose of old stocks.
  - ▲ In March 1997, the MOE's Southwestern Regional Office and Laidlaw Environmental Services Ltd. set up a two-day collection program in London for unwanted or unregistered pesticide products from the agricultural sector. The pesticides collected included 800 kilograms of banned DDT products and other chlorinated pesticides. This pilot project was set up partly to determine the quantity of unwanted or unregistered pesticide stock. Although some stock may be stored inadvertently by Ontario farmers, there is no evidence to indicate that the banned pesticides are being used on agricultural crops.
- *"In cooperation with PCB owners, prepare an inventory and explore options for PCB destruction. Set up decommissioning and destruction targets and time lines for high- and low-level PCBs."*
  - ▲ An inventory of PCBs in Ontario shows that as of December 1998, more than 55 per cent of Ontario's high-level PCBs have been decommissioned and placed into storage, along with associated wastes such as transformer carcasses and contaminated soils. Progress has also been achieved in the destruction of stored PCBs, with 50 per cent of high-level and 30 per cent of lower-level PCBs destroyed as of December 31, 1997.
  - ▲ To encourage efficient and cost effective disposal of PCBs, Environment Canada and the MOE have jointly sponsored PCB Owner Outreach Programs across Ontario targeting small quantity (less than 1 tonne) PCB owners. To date, 1,740 PCB waste storage sites have been identified in Ontario. Presently, 20 per cent of these sites have removed all PCBs for destruction, leaving 1,450 sites to be addressed.

- *"Achieve a 90-per cent reduction by 2000 in the use or release of four other 'Tier I' chlorinated substances (hexachlorobenzene, octachlorostyrene, polychlorodibenzodioxins and polychlorodibenzofurans). In same time frame, significantly reduce the use, generation and release of 26 less toxic 'Tier II' pollutants, including five chlorinated organic compounds: 1,4-dichlorobenzene, 3,3-dichlorobenzidine, hexachlorocyclohexane, 4,4-methylenebis[2-chloroaniline], and pentachlorophenol."*

  - The sources of non-pesticide 'Tier I' and 'Tier II' substances have been updated, and preliminary release/use estimates established. Twelve key sectors are identified for targeted actions. To achieve COA targets, officials from Environment Canada and the MOE are working with key industry sector associations and visiting the major emitters to promote reduction and pollution prevention actions.

Automotive Sector

The Canadian Automotive Manufacturing Pollution Prevention Project was initiated through an MOU signed on May 29, 1992 by the Canadian Vehicle Manufacturers' Association (CVMA), the MOE and Environment Canada. The goal of the project is to produce a verifiable reduction of persistent toxic substances, as well as other environmental contaminants of concern that are used, generated or released by the participating members of the CVMA.

The *Sixth Progress Report*, released in October 1999, contains 24 new case studies to add to the 90 case studies reported previously. Total reductions reported under this project since its inception in May 1992 amount to more than 345,000 tonnes of wastes and environmental contaminants of concern.

A toxics inventory scan was conducted in 1997 by participating CVMA member companies (Chrysler, Ford and General Motors) for substances on the initial list of 65 targeted substances, substances listed in Appendix 2 of the COA as of July 6, 1994, substances listed on CEPA Schedule 1 as of January 1995 and finally the substances concluded to be toxic under the CEPA Priority Substances List process (PSL 1). This scan confirmed that 34 toxic substances were used, generated, or released at CVMA companies' manufacturing operations. These substances include eight chlorinated substances (1,2-dichloroethane, bromochlorofluoromethane, chlorinated paraffins, dichlorobenzenes, dichloromethane (or methylene chloride), PCBs, tetrachloroethylene, and trichloroethylene).

Chlorinated solvents have been eliminated from all Chrysler assembly plants in Canada. New products that contain chlorinated solvents as a major component are detected through a central computerized purchasing system, and are prevented from entering the production facilities. The use of 1,4-dichlorobenzene (sanitary blocks commonly known as "para pucks") has been eliminated from all Chrysler facilities, representing approximately 0.36 tonne per year. Chrysler Canada's National Parts Distribution Centre is now 100 per cent free of PCBs. All PCBs from electrical fixtures and equipment have been destroyed at Alberta's Swan Hills waste treatment facility.

Ford Motor Company of Canada Limited developed a program to treat liquid waste containing PCBs at its Windsor Casting Plant. A mobile chemical dechlorination process was used to treat the PCBs to a concentration of less than two parts per million (ppm). Approximately 55,000 litres of oil containing PCBs in concentrations varying from less than 100 ppm to 330 ppm were successfully treated by the dechlorination process. After treatment, the oil was sent to a licensed recycling facility. The upgrade of Ford's St. Thomas Assembly Plant's wastewater treatment facility was completed in 1996. The replacement of chlorine disinfection with UV disinfection has eliminated the use of 1.4 tonnes of liquid chlorine per year.

In October 1997, General Motors Canada Limited used ELI Eco-Logic technology to destroy its stored PCBs, involving more than 800 tonnes of a broad spectrum of PCB-contaminated materials. General Motors was the first private sector company in Ontario to use this technology. Demonstration of its effectiveness will lead the way for destruction of PCBs at other companies in the future.

More information is available at the CVMA website at http://www.cvma.ca/Programs/Pollution.html.

Automotive Parts Sector

In December 1993, the Automotive Parts Manufacturing Pollution Prevention Project was initiated through the signing of an MOU among the Automotive Parts Manufacturers' Association (APMA), Environment Canada and the MOE. Automotive parts manufacturers are committed under the MOU to voluntarily reduce and/or eliminate the use, generation or release of toxic substances. The task force set up under this project targeted the list of 65 toxic substances published by the CVMA in its pollution prevention project, as well as the additional substances listed in Appendix 2 of the July 6, 1994 COA. The task force released its *Third Progress Report* in April 1999 with 20 new case studies representing an additional 607 tonnes of reductions in substances of environmental concern. These included trichloroethane, trichlorotrifluoroethane, trichloroethylene and other chlorinated solvents.

As a result of converting to a water-based parts washing process, Husky Injection Molding Systems Ltd. eliminated 29.5 tonnes of trichloroethane. The new cleaning system uses an environmentally safe water-based cleaner and a vacuum-assisted wash, rinse and drying system.

Long Manufacturing Ltd. has eliminated the annual use of 130 tonnes of chlorinated solvents, including trichlorotrifluoroethane, trichloroethane and trichloroethylene. These were components of previously used production and maintenance chemicals. The elimination was achieved by thoroughly assessing the cleaning needs of incoming parts from suppliers, modifying stamping dies, and replacing solvents with aqueous cleaning equipment.

Standard Products (Canada) Limited has eliminated trichloroethane from their parts cleaning process by using a water-based cleaning system instead of the traditional solvent vapour degreasing system. Over 67 tonnes per year of trichloroethane atmospheric releases have been eliminated, and 18 tonnes per year of trichloroethane liquid waste have been diverted from disposal.

Pigment Manufacturing – 3,3'-dichlorobenzidine

This substance was assessed and declared toxic under CEPA. Although 3,3'-dichlorobenzidine (3,3'-DCB) itself is not produced, imported or used in Canada, there is one plant that uses DCB salts to manufacture yellow and orange pigments. Following a multi-stakeholder consultation process, a report containing stakeholders' recommendations was prepared and accepted by the Ministers of Environment and of Health. As a result, a data reporting agreement between Environment Canada and the company using DCB salts was negotiated and signed on September 30,1999. Under this agreement, the company submitted a third-party audit report of the environmental management of DCB/DCB salts to Environment Canada in March 2000. The key findings and recommendations of this audit report are being considered to determine what actions are required by the company in order to ensure the life cycle management of DCB to prevent or minimize any releases of 3,3'-DCB.

For additional information, see the 3,3'-DCB Strategic Options Report at: http://www.ec.gc.ca/sop/english/benzidin.htm.

Dye and Pigment Manufacturing Sector – Chloranil

Chloranil, used for dye and pigment production, is imported into Canada but is not produced here. To prevent the release of the chlorinated dioxins and furans present as impurities in chloranil, MOUs between Environment Canada and each of the five importers of chloranil and chloranil-based dyes and pigments were signed in the fall of 1995. The MOUs established a framework for immediate voluntary conversion to low-dioxin chloranil. After a CEPA subsection 16(1) notice was published in Part I of the *Canada Gazette* on May 18, 1996, five additional importers identified themselves. As a result, additional MOUs were signed with each of these importers in late 1997.

Vinyl Sector

The Vinyl Council of Canada launched its Environmental Management Program (EMP) in March 1999, providing a framework to guide manufacturers of vinyl products in the reduction of environmental impacts throughout the life cycle of their products. The EMP is modelled in part on the Canadian Chemical Producers' Association Responsible Care® program, but focuses on the vinyl processing industry. Input in the development of the EMP was provided by Environment Canada, Health Canada and Industry Canada, as well as a public advisory panel involving 11 people active in environmental and public interest groups or relevant institutions.

Current activity under the EMP involves performing a gap analysis of current management practices against those recommended in the EMP, and determining areas of priority in terms of environmental and health impact. Once areas of priority are established, relevant actions will be taken under five commitment areas outlined in the EMP. Specific actions related to the issue of chlorinated substances include the monitoring and reporting of emissions, the implementation of pollution prevention to reduce emissions, and the design and manufacture of products with a goal of no adverse environmental or health impacts through their life cycles.

For additional information, see the Vinyl Council of Canada's web site at: http://www.vinyl.org.

Printing and Graphics Sector

In 1995, the Printing and Graphics Industry Pollution Prevention Project was initiated through an MOU signed by Environment Canada, the MOE, and representatives of the printing and graphics industry. The project focuses on voluntary, verifiable reduction and/or elimination of targeted toxic substance use, generation or release by the printing and graphics firms in Canada. The reduction is accomplished through the development and implementation of pollution prevention projects. The *Third Progress Report* under the MOU, published in March 1999, indicates that more than 20 major corporations and industry associations are participating, and approximately 365 tonnes of toxic substances and other environmental contaminants have been eliminated or reduced since 1995. The list of targeted substances includes the chlorinated substances 1,1,1-trichloroethane and aluminum chloride.

Part 2 – Improving Scientific Understanding

Under the CSAP, the federal government is leading scientific and technical research to improve knowledge of how chlorinated substances affect human health and the environment.

Wildlife Studies

The Canadian Wildlife Service (CWS) conducts research and monitoring at its National Wildlife Research Centre (NWRC) in collaboration with partners from universities, other government agencies and private organizations. By detecting and measuring the effects of toxic substances on wildlife, researchers can assess the overall health of species, predict the impact of pollutants, and provide an early warning system for potential environmental and human health problems. Appendix 3 provides a list of wildlife studies related to chlorinated substances.

Over the past year, research has focused on biological effects attributed to chlorinated substances, including dioxins and furans, PCBs, and other organochlorine (OC) compounds. Among the findings and research activities:

- The influence of chlorinated compounds on liver enzyme activity in polar bears was studied, and PCBs and chlordane were implicated in enzyme induction.
- The Université du Québec à Montréal is collaborating on research with Uppsala University in Sweden to discover potential effects of PCBs, DDE and their metabolites on endocrine disruption in polar bear immune systems and steroid metabolism.
- Studies have demonstrated the bioaccumulation of PCB metabolites in the arctic marine food chain.
- Carleton University's collaborative study is identifying naturally produced halogenated compounds that bioaccumulate in wildlife.
- Trent University's collaborative study is developing a model for predicting bioaccumulation of chlorinated compounds in birds.
- A four-year collaborative study of immune function suppression related to PCB and organochlorine contamination in prefledgling Caspian terns and herring gulls in the Great Lakes was conducted. Suppression of immunity was most severe in colonies in Lake Ontario and Saginaw Bay for both species, and in western Lake Erie for herring gulls. Forty to 50-per cent suppression persisted in both species in 1997.
- Field work was completed on investigations of exposure of wildlife to toxic chemicals at five Atlantic Coastal Action Program (ACAP) sites.
- Dioxins and furans were shown to bioaccumulate in tissues of mink collected downstream from a pulp mill on the St-Maurice River, Quebec.
- A survey of OC, PCB, dioxin and furan accumulation in tree swallows and osprey nestlings was conducted at several ACAP sites in the Maritimes. Field and lab work is complete; journal papers will be submitted in 2000.
- A survey of PCB accumulation and its potential health impacts in otter, mink, raccoon and beaver was carried out in a highly contaminated watershed in Nova Scotia's Five Island Lake. Field collections and pathology work are complete, lab work is under way, and a journal paper will be submitted in 2000.
- Field and lab work is completed on long-term monitoring of OC and PCB levels in seabird eggs on the Atlantic coast of Canada (1972-1996) and a journal paper will be submitted in 2000.

- Monitoring of the clean-up of contamination in the St. Lawrence River is being implemented. The great blue heron and the mudpuppy are being used as wildlife indicators for contaminant levels and effects. OCs and PCBs are measured in great blue heron eggs and fledglings, as well as biochemical endpoints. Significant differences are observed in the level of OCs and PCBs between great blue heron colonies and mudpuppy sampling sites along the river. In the great blue heron, a collaborative study by the Université du Québec à Montréal showed that retinoid levels in eggs and thyroid hormones in blood are correlated with PCB levels in same tissues. Vitamin A in blood and liver was also related to PCBs. A collaborative study of mudpuppies by Université du Québec à Montréal showed higher deformity rates at the most heavily OC-PCB contaminated site.
- A University of Guelph investigation of embryonic deformities in ring-billed gulls shows higher infertility and deformity rates in polluted Great Lakes sites.
- The Great Lakes Herring Gull Eggs Monitoring Program continued. No significant change in OC and PCB contaminants was recorded over the 1991-1995 period.
- An ongoing study of Saskatchewan rivers is evaluating indirect impacts of pulp mill effluents and the adequacy of existing environmental effects monitoring guidelines to protect wildlife. Biochemical, hormonal and reproductive wildlife endpoints are being monitored.
- It has been shown that dioxins, furans and PCBs originating from pulp mills and other industries are declining in the British Columbia environment to levels below the range that is lethal to local wildlife.
- High levels of the persistent contaminant DDE in the Okanagan food chain are under investigation to determine their effects on the developing reproductive system of robins, ospreys and painted turtles.

Environmental Effects Monitoring Studies

Under the *Fisheries Act*, Pulp and Paper Effluent Regulations (1992) require that all pulp mills conduct environmental effects monitoring (EEM). In addition to conducting physical, chemical and biological tests on all effluents, receiving water and biota, those pulp mills using a chlorine-bleaching process must measure and report releases of chlorinated dioxins and furans. They must also conduct analyses of levels of chlorinated dioxins and furans in edible portions of fish.

In some cases, depending on the location of the mill and the process used, other chlorinated substances must be measured and reported. These include chlorophenols, chloroguiacols, chlorocatechols, and chlorinated fatty and resin acids in mill effluents, receiving water and in the tissue of selected fish species. Based on the results of the EEM studies, additional control options may be developed to protect sensitive ecosystems.

Following the completion of the first baseline cycle for EEM in April 1996, a scientific and technical evaluation of the monitoring data was conducted and resulted in refinements to monitoring approaches. Technical guidance documents and the requirements for EEM were updated and revised accordingly. The second cycle was completed on April 1, 2000 for the majority of the mills.

The Pulp and Paper Effluent Regulations are currently under review and proposed amendments to modernize the regulations are expected in the autumn of 2000.

For additional information, see Environment Canada's site on EEM at: http://www.ec.gc.ca/eem/english/default.htm.

Sub-acute Effects of Pulp and Paper Mill Effluents

Environment Canada is continuing research on the reproductive, sub-acute effects of pulp and paper mill effluent constituents. Recent results indicate the presence of fish steroid hormone suppressants, resulting in delayed sexual maturity and reduced egg production in fathead minnows. Causative agents appear to include both non-chlorinated and chlorinated compounds derived from natural products. While several compounds have been isolated and identified, it has been difficult to link them to the reproductive impacts associated with final effluents. Joint studies are under way to isolate the processes responsible for the production or release of the chemicals.

Organochlorines in Organisms and Sediment

Environment Canada, in collaboration with university and industry partners, is conducting research to identify the sources and composition of organochlorine contaminants in sediments and biota. Many of these organochlorines remain to be identified and their effects characterized, but it is known they can move through food webs and affect the health of consumers. Collaborative work with the Canadian Museum of Nature indicates both localized and long-range sources of some organochlorines in the eastern Lake Superior basin.

Atmospheric Transport, Deposition and Accumulation of Persistent Chlorinated Substances

Environment Canada participates in multi-year studies of organochlorine contaminants and their entrance into the food chain through atmospheric exchanges between aquatic and terrestrial surfaces. These studies are part of the Great Lakes 2000 and Northern Contaminants Programs, conducted in cooperation with the Departments of Indian and Northern Affairs, of Health, and of Fisheries and Oceans. Environment Canada is an active participant in the International Atmospheric Deposition Network (IADN) and provides much of the precipitation data for organics and trace metals. Dietary surveys and human exposure studies to assess intakes of chlorinated substances have been completed in the Yukon and Mackenzie regions. Under the second phase of the Northern Contaminants Program, the next few years will involve extensive work in the eastern Arctic in an effort to describe food webs and provide advice to communities on the risks associated with certain natural foods.

Chlorinated Substances in the Great Lakes

A variety of studies are under way on the sources, pathways and effects of organochlorine substances in the Great Lakes. Participants in this work include Environment Canada, through the Great Lakes 2000 program and other initiatives, Fisheries and Oceans Canada, provincial ministries and U.S. government agencies. Present emphasis is on seasonal variations and mass balance assessments of contaminants in precipitation. In the Lake Superior basin, ongoing studies concentrate on watershed retention of atmospherically delivered contaminants at the Turkey Lakes study site. Mass balance studies and long-term trend studies for Lake Huron are in the planning stage.

Under the Great Lakes Health Effects Program, Health Canada is continuing research on the role that chlorinated substances may have in endometriosis and breast and prostate cancers. It is also investigating the cell-transforming activity of environmental contaminant mixtures obtained from human milk. Work continues on the study of risks from chemical contaminants and high-level consumption of Great Lakes fish.

Over the past year, Health Canada has published a major health assessment report entitled *State of Knowledge Report on Environmental Contaminants and Human Health in the Great Lakes Basin*. It has

also published the results of human exposure assessments for 11 substances present in the Great Lakes, including nine chlorinated substances, in *Persistent Environmental Contaminants and the Great Lakes Basin Population: An Exposure Assessment.*

The Great Lakes Health Effects Program also recently published a paper that looks at trends in concentrations of chlorinated hydrocarbons in human breast milk in Canadian populations. The data, drawn from six major surveys of breast milk carried out by Health Canada, shows a downward trend, from 1967 to 1992, in the concentrations of organochlorine pesticides and PCBs.

This breast milk data is also included in the recent Great Lakes Health Effects Program publication *Health-Related Indicators for the Great Lakes Basin Population*. This report presents a series of 20 indicators which, as a whole, serves to monitor human health as it relates to the Great Lakes environment. Chlorinated substances data are an integral component of many of the indicators described in the report.

Endocrine Modulating Substances

Environment Canada is actively involved in research on the endocrine modulating (EM) effects of substances on fish and wildlife. Exposure to these substances can result in effects on reproduction, behaviour, immunocompetence and development. Chlorinated substances currently associated with EM effects are DDT, PCBs and chlorinated dioxins.

An *ad hoc* working group on EM substances has been formed by Environment Canada. Priorities include: identifying regional issues and hot spots; identifying EM effects, particularly in wild populations; identifying sensitive species; developing screening tools to predict the potential EM effect of substances new to Canada; developing better ecological risk assessment methods; and identifying EM substances in environmental samples such as water, sediment and effluents.

The results obtained through these activities may be used in a number of Environment Canada programs to assess the risk that EM substances pose to the environment and health. For substances that are considered toxic under CEPA 1999, risk management options can be undertaken to reduce environmental and health risks. Collaboration with universities and industry will be used to facilitate further research in critical areas. To address the issue of EM substances, Environment Canada will continue to participate in and support the efforts of international organizations such as the OECD.

Part 3 – Studying Public Health and Socio-Economic Effects

Health Studies

Based on the results of past research, and to protect human health, Health Canada has developed tolerance levels in specified foods and drinking water quality guidelines for 28 organochlorine substances. Eleven of these guidelines and tolerance levels were established under the *Food and Drugs Act* (FDA). A list of the chlorinated substances for which tolerance levels and guidelines have been developed can be found in Appendix 5.

Health Canada continues to identify exposure levels and associated adverse effects, and to evaluate the risks to human health posed by a wide array of chemical substances. This work focuses on a number of issues, among which chlorinated substances are being given particular attention. It is undertaken through such mandates as CEPA 1999, the FDA, the *Hazardous Products Act* and the *Pest Control Products Act*.

- Studies are being carried out on the uptake, metabolism, excretion, or toxicity of the following chlorinated substances:
  - chlordane (parent compound, by-products and metabolites)
  - chlorobenzenes
  - chloroform
  - chlorinated or brominated drinking water by-products
  - PCDDs
  - octachlorostyrene
  - PCBs
  - pentachlorophenol
  - toxaphene
  - tri- and tetrachloroethylene
- Health Canada conducts research to examine the effects of chlorinated substances on community health and social structure. The results of these and other studies are used to identify high-risk groups and to formulate appropriate health protection and risk reduction measures, including public information and education initiatives. Appendix 6 includes a list of the studies already published and those expected to be published shortly. Among the major issues being investigated:
  - human exposure studies;
  - levels of organochlorine pesticides, PCBs, polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs and PCDFs) in foods and in human tissues, blood, milk and other body fluids;
  - effects of chlorinated substances in laboratory animal studies; and
  - possible role chlorinated substances play in causing cancer, birth defects, reproductive and other health effects.
- Under CEPA 1999, Health Canada and Environment Canada are conducting risk assessments of five chlorinated substances on the second CEPA Priority Substance List (PSL II). These include aluminum chloride, chloramines, chloroform, hexachlorobutadiene and road salts.
- Health Canada's most recent market food basket analysis on contaminants in commercial food is under way, and the levels of chlorinated compounds detected in food samples will be reported during 2000.
- Studies on several fish-eating populations are under way. In one study, the levels of chlorinated pesticides among Great Lakes anglers tended to be only slightly above population averages.
- Major health assessment reports have been completed on the Great Lakes Basin, the Arctic, and the St. Lawrence River ecosystem. Prepared in co-operation with other agencies in Canada, the reports provide up-to-date information on contaminant levels for those living in these areas. Results show that chlorinated substance levels are highest in Arctic populations, and support the call for international control of persistent chlorinated

compounds. An additional study has recently been completed that gives results of a human exposure assessment for 11 substances found in the Great Lakes basin, nine of which are chlorinated. The reports are available in technical and summary formats.

- Health Canada has established a Chlorinated Disinfection By-Products Task Group to assess the risks from trihalomethanes (THMs) in drinking water and to develop risk management options. The Task Group and its subgroups will: update current THMs risk estimates; estimate health care costs; examine water treatment options and costs; and conduct a risk/cost/benefit analysis. Ultimately a recommendation to revise the current THMs drinking water guideline may be made to the Federal-Provincial Subcommittee on Drinking Water, the organization that develops guidelines for Canadian drinking water quality.

The Canadian Chlorine Coordinating Committee (C4) is funding a collaborative study with Carleton University to develop methods for analysis of PCB metabolites and to examine their pattern in Inuit exposed to high levels of PCBs in the Arctic.

A collaborative study with the Quebec Public Health Centre involving people from the lower North Shore of the St. Lawrence River was conducted. It found high levels of PCBs in human plasma to be correlated with consumption of wild birds' eggs.

Socio-Economic Studies

Three studies have been completed that explore the socio-economic and technical implications of using chlorine and chlorinated substances:

- A chlorine supply and applications study completed in 1994 provides basic technical and economic data on chlorine use and supply in Canada.
- A socio-economic study on options and alternatives to the use of chlorine and chlorinated products (*A Technical and Socio-economic Comparison of Options to Products Derived from the Chlor-alkali Industry*) was completed and released in June 1998. The study examined options to the use of chlorine and chlorinated substances in 28 chlorine and derivative applications. These applications account for approximately three-quarters of the net domestic consumption of chlorine contained in products derived from the chlor-alkali industry. The report indicates that there are alternatives to the use of chlorinated substances in all of the sectors studied.
- A study entitled *A Retrospective Evaluation of Control Measures for Chlorinated Substances* has been completed. This study evaluates the socio-economic impacts of measures that selected countries and industries have implemented to reduce the use and/or release of chlorine and chlorinated substances. The evaluated socio-economic impacts include a comparison of projected and actual costs to industry of implementation, a consideration of the benefits of new technology development and product substitution, and various impacts on the industry and the economy at large, including employment. Case studies were developed for five regulatory and non-regulatory initiatives targeting the use and/or release of a variety of chlorinated substances.

  The study results indicate that cost projections for control measures tend to overestimate the actual costs of implementation. The most important factor is underestimation of the technical and innovative capacity of industry to develop cost-effective solutions. Moreover, the development of alternatives often results in offsetting socio-economic gains in the sectors most impacted by the control measures.

Part 4 – Improved Information for the Canadian Public

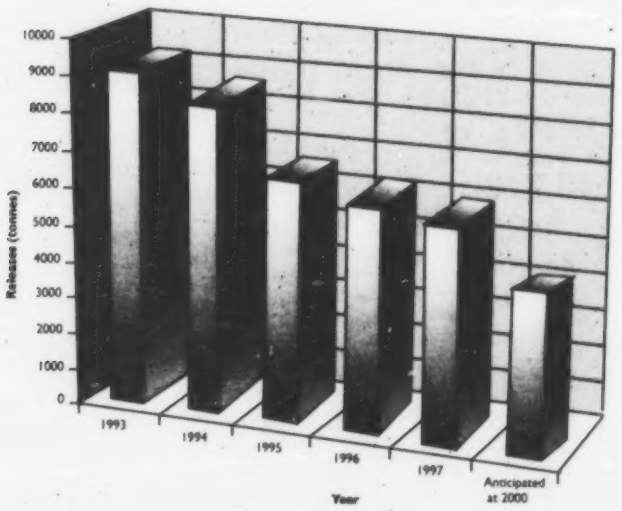
Information allows Canadians to better make important environmental decisions. An important element in the CSAP is ensuring that the latest and best information is made available to Canadians in the most efficient manner.

The National Pollutant Release Inventory

Reporting to the National Pollutant Release Inventory (NPRI) is required by law for those companies which meet certain minimum thresholds. The NPRI is a publicly-available inventory of releases to the environment and transfers in waste, targeting 176 substances, including 34 chlorinated substances (see Appendix 7). As of the 1999 reporting year, 73 new substances, including 22 chlorinated substances, have been added to the NPRI reporting list. The NPRI provides valuable information to the public on the extent and originating location of releases of pollutants by facility, and Summary Reports have been published for reporting years from 1993 through 1997. These reports highlight facilities with the largest releases by sector, province and substance, among other analysis. The reports and other associated information, including an on-line search system that allows access to the data reported from individual facilities, are available on the NPRI web site. The data can also be queried by postal code. The website can be found at: http://www.ec.gc.ca/pdb/npri/.

Analysis of the NPRI data reveals that by 1997, releases of all chlorinated substances excluding hydrochloric acid had been reduced by 30 per cent from 1993 levels. By the year 2000, total reductions of almost 45 per cent from 1993 levels are anticipated. (Results are shown in Figure 3.) In order to improve the effectiveness of the NPRI program, Environment Canada is consulting stakeholders on a number of issues including criteria for

Figure 3
NPRI Actual and Anticipated Releases of Chlorinated Substances (excluding Hydrochloric acid)



Graph source: NPRI data

Hydrochloric acid is excluded from the graph because the large releases of this substance overwhelm releases of the other chlorinated substances reported to NPRI. Releases of hydrochloric acid have been gradually increasing from 1993 to 1997.

adding and deleting substances and changing reporting thresholds.

Environment Canada's Green Lane on the Internet

Environmental information on many topics, including chlorine-containing substances, is now available electronically via the Green Lane, Environment Canada's Internet site. It provides interactive access to Environment Canada services, products, information holdings, policies and programs. The CSAP Progress Report is available on the Green Lane and provides links to other related sites. The Green Lane is located at http://www.ec.gc.ca.

Health Canada's Internet Site

Information on chlorine issues relating to human health can be found on the Health Canada Internet site. Resources are available for issues ranging from contaminant exposure studies to drinking water and food quality guidelines for chlorinated substances. Health Canada's site can be found at http://www.hc-sc.gc.ca.

The State of Canada's Environment

Canada's third national state of the environment (SOE) report is a comprehensive five-year overview of the state of Canada's environment. The report includes information on chlorinated substances such as PCBs, dioxins and pesticides in several chapters, including those on specific regional ecosystems, the national perspectives, and toxic substances.

As of June 1998, there were over 6,000 subscribers to the Internet version of the 1996 SOE Report, and sales of over 4,000 copies of the CD-ROM and hard copy versions.

Although publication of the comprehensive five-year national report is being discontinued, the SOE Reporting Program will continue to produce issue- and area-specific reports and assessments, as well as bulletins on specific environmental indicators. These will cover a range of issues and topics, some of which address chlorinated substances.

One example is the updated *Environmental Indicator Bulletin: Toxic Contaminants in the Environment: Persistent Organochlorines* published by Environment Canada in early 1998. This document outlines the findings of long-term studies to monitor levels of persistent organochlorines in widespread species such as the Double-Crested Cormorant. According to the bulletin, concentrations of DDE, a chlorinated chemical produced when the pesticide DDT breaks down, have declined significantly in cormorant eggs. Levels of chlorinated dioxins and furans also declined significantly because they were reduced in pulp mill effluent. In contrast, the decline of PCB levels in cormorant eggs has been inconsistent, with some recent increased levels observed at some sites. This may reflect the fact that there are still some PCBs in use.

Bulletins published under the SOE Reporting Program, as well as the 1996 SOE Report, are available at: http://www1.ec.gc.ca/~soer.

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Part 5 – Promoting and Leading International Efforts

The Chlorinated Substances Action Plan forms part of the foundation for Canada's position as a leader in the international arena. The experience Canada gained through the implementation of the CSAP is valuable in the development and implementation of international efforts to curtail use of many toxic chlorinated substances – while encouraging precaution in the use of other chlorine-containing compounds. A list of chlorinated substances targeted for action through international protocols is included in Appendix 8.

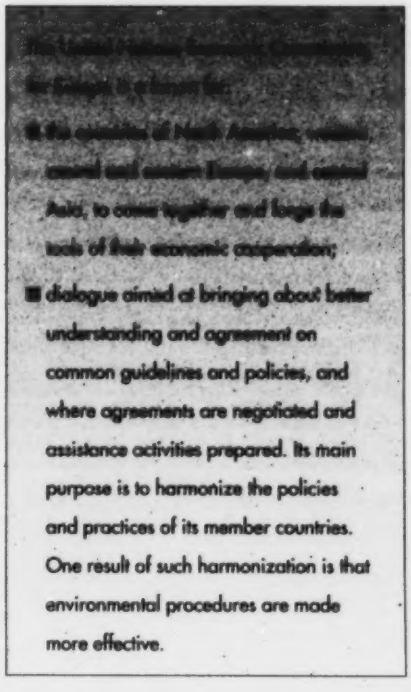
Action on Persistent Organic Pollutants through UN/ECE and UNEP

In February 1998, following several years of negotiations by Canada, the United Nations Economic Commission for Europe (UN/ECE) adopted a Protocol on Persistent Organic Pollutants (POPs) under the Convention on Long-range Transboundary Air Pollution (LRTAP). The key elements of the Protocol include an initial list of 16 organic pollutants, 14 of which are chlorinated. It also includes associated control actions to be implemented for each substance as well as a process for adding future substances. The chlorinated substances included in the Protocol are aldrin, endrin, heptachlor, chlordane, lindane (gamma hexachlorocyclohexane), hexachlorobenzene, dieldrin, mirex, PCBs, DDT, toxaphene, chlordecone, and chlorinated dioxins and furans. The obligations in the Protocol are consistent with current management initiatives in Canada.

The Protocol has been signed by Canada, the European Union, and 34 other countries. On December 18, 1998, Canada was the first country to ratify the Protocol, committing itself to fulfill its obligations through current management initiatives under the TSMP. Implementation of the commitments contained in the Protocol by Canada and other participating countries will contribute to reducing emissions of the airborne pollutants that accumulate in the Canadian environment.

In February 1997, the United Nations Environment Programme (UNEP) Governing Council responded to growing calls for action on POPs by providing a mandate for an International Negotiating Committee (INC) to prepare a global POPs Agreement. The negotiations will address an initial list of 12 POPs (which are also the 12 Track 1 substances under TSMP), as well as establish science-based criteria for identifying future candidates. In June 1998, Canada hosted the initial INC meeting in Montreal. At that meeting, Dr. John Buccini of Environment Canada was elected Chair of the INC for its duration. Negotiations are expected to conclude by the end of 2000.

For additional information, see the UN/ECE LRTAP site at: http://www.unece.org/env/lrtap/welcome.html, or the UNEP POPs site at http://irptc.unep.ch/pops/.



- dialogue aimed at bringing about better understanding and agreement on common guidelines and policies, and where agreements are negotiated and assistance activities prepared. Its main purpose is to harmonize the policies and practices of its member countries. One result of such harmonization is that environmental procedures are made more effective.

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The United Nations Economic Commission for Europe is a forum for:

- **the countries of North America, western, central and eastern Europe, and central Asia, to come together and forge the tools of their economic cooperation;**
- **dialogue aimed at bringing about better understanding and agreement on common guidelines and policies, and where agreements are negotiated and assistance activities prepared. Its main purpose is to harmonize the policies and practices of its member countries. One result of such harmonization is that environmental procedures are made more effective**

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North American Free Trade Agreement – Commission for Environmental Cooperation

The North American Agreement on Environmental Cooperation Resolution on Sound Management of Chemicals is an environmental side agreement to NAFTA. Under its provisions, Canada, the United States and Mexico agreed to develop North American Regional Action Plans (NARAPs) for four priority substances, three of which are chlorinated. Action plans for PCBs, DDT, and chlordane have been finalized. At the June 1999 CEC Council meeting in Banff, it was decided to develop additional NARAPs for dioxins and furans and hexachlorobenzene.

For additional information, see the CEC site at: http://www.cec.org.

Great Lakes Binational Toxics Strategy

In keeping with the obligations of the *Great Lakes Water Quality Agreement*, Canada and the United States signed the *Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes* on April 7, 1997. This strategy is also known as the Great Lakes Binational Toxics Strategy. It sets forth a collaborative process for Canada and the U.S. to work together on the goal of virtual elimination from the Great Lakes basin of persistent bioaccumulative toxic substances resulting from human activity, and to protect and ensure the health and integrity of the Great Lakes ecosystem.

The strategy establishes reduction goals for an initial list of persistent toxic substances that are targeted for virtual elimination. Chlorinated substances on this list are aldrin/dieldrin, chlordane, DDT, hexachlorobenzene, mirex, octachlorostyrene, PCBs, polychlorodibenzodioxins, polychlorodibenzofurans, and toxaphene. These substances were included because they have been associated with widespread, long-term adverse effects on wildlife in the Great Lakes, and because their bioaccumulative properties are of concern to human health.

For additional information, see the Great Lakes Binational Toxics Strategy site at: http://www.epa.gov/grtlakes/p2/bnsintro.html.

Arctic Monitoring and Assessment Program

The Arctic Monitoring and Assessment Programme (AMAP) was established in 1991 as a component of the Arctic Environmental Protection Strategy (AEPS). After the 4th Ministerial Meeting of the AEPS in 1997 at Alta, Norway, the program was placed under the Arctic Council (established on September 19, 1996). Eight nations are members of this Council: Canada, United States, Russia, Iceland, Norway, Sweden, Finland, and Denmark.

The main goal of AMAP is to provide reliable and sufficient information on the status of, and threats to, the Arctic environment, and to provide scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants.

The scope of the monitoring and assessment program includes: sources of pollution both within the Arctic region and at lower latitudes; pathways of pollutant transfer to and within the Arctic; levels and trends; fate of pollutants; and effects on Arctic ecosystems and human populations. POPs, many of which are chlorinated, are included in AMAP.

Phase I of the AMAP (1992-1997) has been completed with the release of two reports on the AMAP assessment of Arctic pollution. *Arctic Pollution Issues: A State of the Arctic Environment Report* is a comprehensive summary of the AMAP assessment. The *AMAP Assessment Report: Arctic Pollution Issue* is a fully referenced scientific report on the AMAP assessment of Arctic pollution.

Phase II of the AMAP (1998-2003) was launched in 1998. Participating countries have updated the AMAP core monitoring programs from Phase I, and further developed the monitoring sub-programs for the priority pollutants. They will also focus on filling gaps in data and information identified in the AMAP assessment reports. Some specific areas of

activity for AMAP Phase II include adding new monitoring stations, expanding health effects monitoring to include a greater proportion of the Arctic populations, establishing a marine program, addressing combined effects of pollutants, and compiling an inventory of Arctic pollution sources.

For additional information, see the AMAP web site at: http://www.grida.no/amap/.

Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities

In November 1995, Canada was one of the 110 nations to adopt the UNEP Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities. POPs were among the eight source categories identified for action.

Canada will soon release its National Programme of Action (NPA) which gives POPs a high priority. One of the key recommendations calls for strengthened control of non-point sources.

The Arctic Council adopted a Regional Programme of Action (RPA) for the region in September 1998. POPs are also given a high priority in the RPA, which highlights the need to address major pollution sources in the Russian Federation.

For additional information, see the UNEP GPA website at http://www.gpa.unep.org and Canada's NPA website at http://www.ec.gc.ca/marine/npa-pan.

Appendix 1

SUBSTANCES LISTED IN APPENDIX 2 OF THE CANADA-ONTARIO AGREEMENT OF JULY 6, 1994

TIER I SUBSTANCES	TIER II SUBSTANCES
Aldrin/dieldrin*	Anthracene
Benzo(a)pyrene	Cadmium
Chlordane*	1,4-dichlorobenzene*
Dichlorodiphenyl Trichloroethane (DDT*	3,3'-dichlorobenzidine*
Hexachlorobenzene*	Dinitropyrene
Alkyl-lead	Hexachlorocyclohexane*
Mercury	4,4'-methylenebis(2-chloroaniline)*
Mirex*	Pentachlorophenol*
Octachlorostyrene*	Tributyl tin
PCBs*	17 PAHs as a group, including but not limited to:
Polychlorinated dibenzodioxins*	Benz(a)anthracene
Polychlorinated dibenzofurans*	Benzo(b)fluoranthene
Toxaphene*	Benzo(g,h,i)perylene
	Perylene
	Phenanthrene

* chlorinated substance

CANADIAN VEHICLE MANUFACTURERS' ASSOCIATION POLLUTION PREVENTION PROJECT

Chlorinated substances on the targeted list of the MOU which are used, generated or released in participating companies' manufacturing operations:

1,2-dichloroethane
Bromochlorofluoromethane
Chlorinated paraffins
Dichlorobenzenes
Methylene chloride (dichloromethane)
Polychlorinated biphenyls (PCBs)
Tetrachloroethylene
Trichloroethylene

Appendix 2

REDUCTIONS IN CHLORINATED SUBSTANCES EMISSIONS BY ARET PARTICIPANTS

Substance	Annual Emissions (kg)			
List A-1	**Base Year**	**1993**	**1998**	**2000 (projected)**
Pentachlorophenol	569	53	3.8	3.9
Hexachlorobenzene	69	67	0	0
2,3,7,8-tetrachlorodibenzofuran	0.90	0.025	5.3×10^{-3}	6.1×10^{-3}
Octachlorostyrene	0.70	0	0	0
2,3,7,8-tetrachlorodibenzo-p-dioxin	0.15	3.2×10^{-3}	7.2×10^{-4}	3.2×10^{-4}
Polychlorinated Biphenyls (PCBs)	0.038	0	0	0
4,4'-methylenebis(2-chloroaniline)	RNEE	RNEE	RNEE	RNEE
alpha-hexachlorocyclohexane	NR	NR	NR	NR
gamma-hexachlorocyclohexane	NR	NR	NR	NR
Total – List A-1	**640**	**121**	**3.8**	**3.9**
Reduction Achieved from Base Year		**81%**	**99%**	**99%**

RNEE – Reported but no emission estimate available
NR – Not reported

REDUCTIONS IN CHLORINATED SUBSTANCES EMISSIONS BY ARET PARTICIPANTS

Substance	Annual Emissions (kg)			
List A-2 and B	**Base Year**	**1993**	**1998**	**2000 (projected)**
Chlorine dioxide	2,040,335	1,661,105	615,534	426,345
Methylene chloride	1,087,588	1,058,059	937,428	371,737
Chloroform	751,813	416,340	157,303	76,641
1,1,2,2-tetrachloroethylene	265,581	177,875	4,657	8,241
1,1,2-trichloroethylene	126,373	44,973	22,055	26,112
Carbon tetrachloride	81,336	39,368	783	676
1,2-dichloroethane	70,312	20,054	27,007	23,395
1,4-dichlorobenzene	27,725	26,214	8,231	5,174
2,4,6-trichlorophenol	4,981	970	6.8	4.1
2,4-dichlorophenol	1,385	1,003	12	9.0
Epichlorohydrin	754	183	1.0	1.0
2,3,4,6-tetrachlorophenol	426	137	3.8	38
Chlorodibromomethane	301	301	298	298
Bromodichloromethane	121	77	42	12
alpha-chlorotoluene	20	20	8	10
bis(2-chloroethyl)ether	16	ND	11	10
Hexachlorocyclopentadiene	6.0	6.0	6.0	6.0
1,3 dichloropropene	RNEE	RNEE	RNEE	RNEE
3,3' dichlorobenzidine	RNEE	RNEE	RNEE	RNEE
1,2-dibromo-3-chloropropane	NR	NR	NR	NR
1,2-dichlorobut-3-ene	NR	NR	NR	NR
1-bromo-2-chloroethane	NR	NR	NR	NR
1-chloro-4-nitrobenzene	NR	NR	NR	NR
bis(chloromethyl) ether	NR	NR	NR	NR
Total – Lists A-2 and B	**4,459,072**	**3,446,685**	**1,773,387**	**941,718**
Reduction Achieved from Base Year		**23%**	**60%**	**79%**
Total – all lists	**4,459,712**	**3,446,806**	**1,773,391**	**941,722**
Reduction Achieved from Base Year		**23%**	**60%**	**79%**

RNEE – Reported but no emission estimate available
NR – Not reported
ND – Non-detectable

Appendix 3

WILDLIFE PUBLICATIONS RELATED TO CHLORINATED SUBSTANCES

1996

Bandiera, S.M., S.M. Torok, R.J. Letcher and R.J. Norstrom. 1996. Immunoquantitation of cytochromes P450 1A and 2B and comparison with chlorinated hydrocarbon levels in archived polar bear liver samples. Chemosphere 34: 1469-1479.

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Champoux, L. 1996. PCBs, dioxins and furans in Hooded Merganser (Lophodytes cucullatus), Common Merganser (Mergus merganser) and mink (Mustela vison) collected along the St. Maurice River near La Tuque, Quebec. *Environmental Pollution* 92(2): 147-153.

Champoux, L., J.L. DesGranges, J. Rodrigue, S. Trudeau, M. Boily, A. Hontela et P.A. Spear.1996. St. Lawrence River ecosystem monitoring: the Great Blue Heron and Black-Crowned Heron colony of Dickerson Island, Lake St. Francis, Québec. In: R.D. Needham et E.M. Novakowski (eds.), Conference proceedings of sharing knowledge, linking science and international conference on the St. Lawrence ecosystem, Cornwall, Ontario, May 10-12, 1995, pp. 195-210.

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Grasman, K.A., G.A. Fox, P.F. Scanlon and J.P. Ludwig. 1996. Organochlorine-associated immunosuppression in prefledging Caspian terns and herring gulls from the Great Lakes: an ecoepidemiological study. *Environmental Health Perspectives* 104(Suppl. 4): 829-842.

Hahn, M.E., B.L. Woodward, J.J. Stegeman and S.W. Kennedy. 1996. Rapid assessment of induced cytochrome P4501A protein and catalytic activity in fish hepatoma cells grown in multiwell plates: Response to TCDD, TCDF, and two planar PCBs. *Environ. Toxicol. Chem.* 15: 582-591.

Hebert, C.E., M. Gamberg, L. Mychasiw, B.T. Elkin, M. Simon and R.J. Norstrom. 1996. Polychlorinated dibenzodioxins, dibenzofurans and non-ortho substituted polychlorinated biphenyls in caribou (Rangifer tarandus) from the Canadian Arctic. *The Science of the Total Environment* 185: 195-204.

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Letcher, R.J., R.J. Norstrom and D.C.G. Muir. 1996. The bioaccumulation and metabolic formation of methyl sulfone PCB and 4,4'-DDE metabolites in the polar bear food chain. Dioxin '96, University of Amsterdam, *Organohalogen Compounds* 29: 500-505.

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Appendix 4

CANADIAN ENVIRONMENTAL QUALITY GUIDELINES FOR PRIORITY CHLORINATED SUBSTANCES (developed under the auspices of the CCME)

FRESHWATER QUALITY GUIDELINES

Atrazine
Chlorinated benzenes
- monochlorobenzene
- 1,2-dichlorobenzene
- 1,3-dichlorobenzene
- 1,4-dichlorobenzene
- 1,2,3-trichlorobenzene
- 1,2,4-trichlorobenzene
- 1,2,3,4-tetrachlorobenzene
- pentachlorobenzene

Chlorinated ethanes
- 1,2-dichloroethane

Chlorinated ethenes
- tetrachloroethene (tetrachloroethylene)
- trichloroethene (trichloroethylene)

Chlorinated phenols
- monochlorophenol
- dichlorophenols
- trichlorophenols
- tetrachlorophenols
- pentachlorophenol

Chlorinated methanes
- dichloromethane
- trichloromethane (chloroform)
- tetrachloromethane

Chlorothalonil
Chlorpyrifos
Cyanazine
DDAC (Didecyl dimethyl ammonium chloride)
Dicamba
Diclofop-methyl
Endosulfan
Hexachlorobutadiene
Linuron
MCPA
Metolachlor
Phenoxy herbicides
Picloram
Reactive Chlorine (free and combined chlorine; i.e. hypochlorous acid and monochloramine)
Simazine
Triallate

MARINE QUALITY GUIDELINES

Chlorinated benzenes
- monochlorobenzene
- 1,2-dichlorobenzene
- 1,2,4-trichlorobenzene

Chlorothalonil
Chlorpyrifos
MCPA
Reactive Chlorine / Chlorine produced oxidants

SEDIMENT QUALITY GUIDELINES (for freshwater and marine ecosystems)

Aroclor 1254
Chlordane
DDD
DDE
DDT
Dieldrin
Endrin
Heptachlor epoxide
Lindane
PCBs
Toxaphene

Sediment quality guidelines under development

Polychlorinated dibenzo-*p*-dioxins
Polychlorinated dibenzofurans

SOIL QUALITY GUIDELINES

Chlorinated ethenes
- Tetrachloroethylene
- Trichloroethylene

Chlorinated phenols
- Pentachlorophenol

DDT
PCBs

Soil quality guidelines under development

Polychlorinated diobenzo-p-dioxins
Polychlorinated dibenzofurans

TISSUE RESIDUE GUIDELINES

DDT (total)
PCBs
Toxaphene

Tissue residue guidelines under development

Polychlorinated dibenzo-p-dioxins
Polychlorinated dibenzofurans

Appendix 5

CHLORINATED SUBSTANCES FOR WHICH DRINKING WATER QUALITY GUIDELINES AND/OR FOOD TOLERANCES HAVE BEEN ESTABLISHED BY HEALTH CANADA

1,1-Dichloroethylene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,4-Dichlorobenzene
2,3,4,6-Tetrachlorophenol
2,4,6-Trichlorophenol
2,4-Dichlorophenol
Aldrin + dieldrin
Atrazine + n-dealkylated metabolites
Atrazine + metabolites*
Carbon tetrachloride
Chloramines
Chlorpyrifos*
Cyanazine*
Dicamba*
Dichlorophenoxyacetic acid, 2,4- (2,4-d)*
Dichloromethane
Diclofop-methyl*
Methoxychlor*
Metolachlor*
Monochlorobenzene
Pentachlorophenol*
Picloram*
Simazine*
Tetrachloroethylene
Trichloroethylene
Trihalomethanes (total)
Vinyl chloride

* Food Tolerances and Drinking Water Quality Guidelines established under the *Food and Drugs Act*

Appendix 6

HEALTH PUBLICATIONS RELATED TO CHLORINATED SUBSTANCES PRIOR TO 1995

Bourque, A., Singh, A., Dykeman, A., McMahon, A., and Foster, W. (1994) Hexachlorobenzene at low doses produces lesions in non-human primate ovary. *Experientia*, 50:A87.

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Appendix 7

CHLORINATED SUBSTANCES ON THE NATIONAL POLLUTANT RELEASE INVENTORY (NPRI)

Inorganic Acids
Hydrochloric acid

Other Inorganic Substances
Chlorine
Chlorine dioxide
Titanium tetrachloride

Colourants
C.I. Food Red 15 ($C_{18}H_{31}ClN_2O$)
C.I. Basic Green ($C_{23}H_{25}ClN_2$)

Halogenated Organic Substances
*1,1,1,2-Tetrachloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,2-Dichloroethane
1,2-Dichloropropane
*1-Bromo-2-chloroethane
2,4-Dichlorophenol (and its compounds)
*3,3'-Dichlorobenzidine dihydrochloride
*3-Chloro-2-methyl-1-propene
*3-Chloropropionitrile
4,4'-Methylene*bis* (2-chloroaniline)
*Alkanes, C_{6-18}, chloro
*Alkanes, C_{10-13}, chloro
Allyl chloride
Benzyl chloride (Alpha-chlorotoluene)
Benzoyl chloride
Carbon tetrachloride
Chlorendic acid
*Chloroacetic acid (and its compounds)
Chloroethane
Chloroform
Chloromethane
Dichloromethane
Epichlorohydrin
Ethyl chloroformate
Hexachlorocyclopentadiene
Hexachloroethane
*Hexachlorophene
*Pentachloroethane
Phosgene
Tetrachloroethylene
*Tetracycline hydrochloride
Trichloroethylene
Vinyl chloride
Vinylidene chloride

Chlorobenzenes
1,2,4-Trichlorobenzene
Chlorobenzene
o-Dichlorobenzene
p-Dichlorobenzene

Ozone-depleting substances
*CFC-11
*CFC-12
*CFC-13
*CFC-114
*CFC-115
*HCFC-22
*HCFC-122 (mixture)
*HCFC-123 (and all isomers)
*HCFC-124 (and all isomers)
*HCFC-141b
*HCFC-142b

*** Substances added to the list of NPRI substances for the 1999 reporting year.**

Appendix 8

CHLORINATED SUBSTANCES TARGETED BY SELECTED INTERNATIONAL INITIATIVES

SUBSTANCE	UN/ECE LRTAP	UNEP	CAN/U.S. Bilateral Toxics Strategy (Level I)	NAFTA/ CEC
Aldrin	●	●	●	
Chlordane	●	●	●	●
Chlordecone	●			
DDT (+DDD+DDE)	●	●	●	●
Dieldrin	●	●	●	
Endrin	●	●		
Heptachlor	●	●		
Hexachlorobenzene	●	●	●	●
Hexachlorocyclohexane (incl. Lindane)	●			
Mirex	●	●	●	
Octachlorostyrene			●	
PCBs	●	●	●	●
PCDDs (dioxins)	●	●	●	●
PCDFs (furans)	●	●	●	●
Toxaphene	●	●	●	

UN/ECE = United Nations Economic Commission for Europe
LRTAP = Long-range Transboundary Air Pollution
UNEP = United Nations Environment Programme
NAFTA = North American Free Trade Agreement
CEC = Commission for Environmental Cooperation

Appendix 9

PROGRAMS & MEASURES DEALING WITH CHLORINATED SUBSTANCES

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA/ PSL	ARET	NPRI	AGREEMENTS (MOUs)	GUIDELINES/ CODES	REG'S	INTERNAT'L ACTIONS
ORGANIC							
1,1-Dichloroethylene					●		
1,1,1-Trichloroethane (methyl chloroform)	PSL1(T) Sch.1			●	●	●	●
1,1,2,2-Tetrachloroethane	PSL1(NT)		●		●		
1,2-Dibromo-3-chloropropane	Sch.2(PII)	B-3					
1,2-Dichlorobenzene	PSL1(NT)				●		
1,2-Dichlorbut-3-ene		B-3					
1,2-Dichloroethane	PSL1(T) Sch.1 Sch.2(PII)	B-2	●	●	●		
1,2-Dichloropropane			●	●			
1,2,4-Trichlorobenzene			●		●		
1,3-Dichloropropene		B-3					
1,4-Dichlorobenzene	PSL1(NT)	A-2	●	●	●		●
1-Bromo-2-chloroethane		B-3			●		
1-Chloro-4-nitrobenzene		B-3			●		
2,3,4,6-Tetrachlorophenol		B-2			●		
2,3,7,8-Tetrachlorodibenzodioxin		A-1					
2,3,7,8-Tetrachlorodibenzofuran		A-1					
2,4,6-Trichlorophenol		B-1		●	●		
2,4-Dichlorophenol		B-3	●		●		
3,3'-Dichlorobenzidine	PSL1(T) Sch.1	B-1		●			●

ARET = Accelerated Reduction / Elimination of Toxics
[A-1 = PBT; A-2 = consensus not reached on PBT status; B-1 = BT; B-2 = PT; B-3 = T]

CEPA = Canadian Environmental Protection Act
[Sch.1 = Schedule 1 - List of Toxic Substances; Sch.2(PI) = Schedule 2, Part I - List of Prohibited Substances; Sch.2(PII) = Schedule 2, Part II - List of Toxic Substances Requiring Export Notification]

PSL1 and PSL2 = Priority Substances Lists 1 and 2
(PSL1(T) = Assessed as toxic; PSL1(NT) = Assessed as not toxic or insufficient information to conclude toxicity)

NPRI = National Pollutant Release Inventory

Codes = Code of Practice

Guidelines: Technical, Environmental Quality, Drinking Water Quality, or Food Tolerances

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA/ PSL	ARET	NPRI	AGREEMENTS (MOUs)	GUIDELINES/ CODES	REG'S	INTERNAT'L ACTIONS
ORGANIC							
4,4'-Methylenebis(2-chloroaniline)		A-1	●				
(4-chlorophenyl)cyclo-propylmethanone, O-[(4-nitrophenyl)methyl]oxime	Sch.1						
Allyl chloride			●				
Alpha-chlorotoluene		B-2	●	●			
Alpha-hexachlorocyclohexane		A-1					●
Benzoyl chloride			●				
Bis(chloromethyl)ether	PSL1(T) Sch.1 Sch.2(PI)	B-3				●	
Bis(2-chloroethyl)ether	PSL1(NT)	B-2					
Bromochlorodifluoromethane	Sch.1 Sch.2(PII)					●	●
Bromodichloromethane		B-2					
Carbon tetrachloride	Sch.1 Sch.2(PII)	B-2	●	●	●	●	●
Chloranil (tetrachlorobenzoquinone)				●			
Chlorinated wastewater effluents	PSL1(T) Sch.1			●			●
Chloroacetic acid			●				
Chloroamines	PSL2						
Chlorobenzene	PSL1(NT)		●				
Chlorodibromomethane		B-2					
Chloroethane			●	●			
Chlorofluorocarbons	Sch.1 Sch.2(PII)					●	●
Chloroform	PSL2	B-2	●	●	●		
Chloromethane			●	●	●		
Chloromethyl methyl ether	PSL1(T) Sch.1 Sch.2(PI)		●			●	

ARET = Accelerated Reduction / Elimination of Toxics
[A-1 = PBT; A-2 = consensus not reached on PBT status; B-1 = BT; B-2 = PT; B-3 = T]

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CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA/ PSL	ARET	NPRI	AGREEMENTS (MOUs)	GUIDELINES/ CODES	REG'S	INTERNAT'L ACTIONS
ORGANIC							
Dichlorophenoxyacetic acid					●		
Dichloromethane (methylene chloride)	PSL1(T) Sch.1	B-2	●	●	●		
Effluent from pulp mills using bleaching	PSL1(T) Sch.1						
Epichlorohydrin		B-3	●	●			
Ethyl chloroformate			●				
Hexachlorobutadiene	PSL2				●		
Hexachlorocyclopentadiene		B-1	●				
Hexachloroethane			●	●			
Hydrochlorofluorocarbons (HCFC)	Sch.1						
Octachlorostyrene		A-1		●			●
Pentachlorobenzene	PSL1(NT)						●
Phosgene (carbonyl chloride)			●				
Polychlorinated biphenyls (PCBs)	Sch.1 Sch.2(PII)	A-1		●	●	●	●
Polychlorinated dibenzodioxins	PSL1(T) Sch.1			●	●	●	●
Polychlorinated dibenzofurans	PSL1(T) Sch.1			●	●	●	●
Polychlorinated terphenyls	Sch.1 Sch.2(PI)						
Quintozene (pentachloronitrobenzene)							●
Short-chain chlorinated paraffins	PSL1(T)						
Tetrachlorobenzenes	PSL1(NT)						●
Tetrachloroethylene (perchloroethylene)	PSL1(T) Sch.1	B-2	●	●	●		
Trichlorobenzenes	PSL1(NT)						
Trichloroethylene	PSL1(T) Sch.1	B-3	●	●	●		
Trihalomethanes					●		
Vinyl chloride	Sch.1		●		●	●	
Vinylidene chloride			●				

CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA/ PSL	ARET	NPRI	AGREEMENTS (MOUs)	GUIDELINES/ CODES	REG'S	INTERNAT'L ACTIONS
INORGANIC							
Aluminum chloride	PSL2						
Arsenic trichloride			●		●		
Cadmium chloride			●		●		
Chlorine			●				
Chlorine dioxide		B-3	●	●			
Chromic chloride			●		●		
Chromous chloride			●		●		
Chromyl chloride			●		●		
Hydrochloric acid			●		●	●	
Mercuric chloride	Sch.2(PII)		●				
Mercurous chloride	Sch.2(PII)		●				
Titanium tetrachloride			●	●			

ARET = Accelerated Reduction / Elimination of Toxics
[A-1 = PBT; A-2 = consensus not reached on PBT status; B-1 = BT; B-2 = PT; B-3 = T]

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CHEMICAL SUBSTANCE	PROGRAMS/MEASURES IN PLACE OR UNDER DEVELOPMENT						
	CEPA/ PSL	ARET	NPRI	AGREEMENTS (MOUs)	GUIDELINES/ CODES	REG'S	INTERNAT'L ACTIONS
PESTICIDES (governed by the Pest Control Product Act)							
Aldrin (no longer registered – 1985)	Sch.2(PII)			●	●		●
Alochlor	Sch.2(PI)						
Atrazine (registered 1985)					●		
Chlordane (discontinued – 1990)	Sch.2(PII)			●	●		●
Chlordecone (discontinued –1995)							●
Chlorothalonil (registered)							
Cyanazine (registered)					●		
Chlorpyrifos(registered)					●		
DDD (DDT metabolite)					●		●
DDE (DDT metabolite)					●		●
DDT (discontinued)	Sch.2(PII)			●	●		●
Dicamba (registered)					●		
Diclofop-methyl (registered)					●		
Dieldrin (discontinued – 1990)	Sch.2(PII)				●		●
Endosulfan (registered)					●		
Endrin (discontinued – 1990)	Sch.2(PII)				●		●
Heptachlor (discontinued)					●		●
Heptachlor epoxide (never registered)					●		●
Hexachlorobenzene (discontinued – 1976)	PSL1(T) Sch. 1	A-1		●	●		●
Leptophos	Sch.2(PI)						
Lindane (Hexachlorocyclohexane) (registered)	Sch.2(PII)	A-1		●	●		●
Linuron (registered)					●		
MCPA (registered)					●		
Methoxychlor (registered)					●		●
Metolachlor (registered)					●		
Mirex (never registered)	Sch.1						
Sch.2(PI)			●		●	●	
Phenoxy herbicides (2,4-D) (registered)					●		
Pentachlorophenol (limited registration – 1990)		A-1		●	●		●
Phosphamidon	Sch.2(PI)						
Picloram (registered)					●		
Simazine (registered)					●		
Toxaphene (discontinued)				●	●		●
Triallate (registered)					●		

Appendix 10

*Industry progress related to the Chlorinated Substances Action Plan**

1.0 Overview

The Canadian Chlorine Coordinating Committee **(C4)** supports Environment Canada's Chlorinated Substances Action Plan **(CSAP)** and its comprehensive approach to the management of chlorinated substances. This support is demonstrated through both voluntary and regulated action.

The Vision of C4 is *The Responsible Use of Chlorine Chemistry Resulting in Societal Benefit Recognized by the Public.* The Mission and Principles of C4 are available from the C4 office at (905)678-7405.

2.0 Targeted Actions

2.1 Stewardship Case Studies

C4 is producing a series of brief industrial action case studies to demonstrate company stewardship in a concise readable form.

In 1989, Dow Chemical Canada Inc.'s Sarnia Site committed to a River Separation Project to eliminate spills and harmful discharges to the St. Clair River by the year 2000. Major projects being undertaken as part of this initiative include: installing new sewers, separating sewer systems, building containment facilities and using reduce/reuse/recycle techniques to manage water usage more effectively.

Since the River Separation Project was announced in 1989, daily discharges of organic chemicals of concern have been reduced by 97 per cent from an average of 8 kilograms per day to an average of 0.2 kilograms per day in 1997.

Copies of this and other case studies are available from the C4 office.

2.2 Responsible Care®

Under Responsible Care®, all Canadian Chemical Producers' Association **(CCPA)** members and partners commit to implement the life cycle management codes of practice within three years of joining the association. At the end of that three-year period, each company's implementation is verified by a four-person team consisting of two industry experts, a community interest representative, and a local representative selected by the plant community. To meet the continuous improvement promise of Responsible Care®, they issue a public report on the soundness of the company's management systems in the areas of environment, health, safety, R&D, transportation, product stewardship, purchasing, waste management, etc. This process has essentially been completed for all but the newest members of CCPA. Areas where companies have exceeded expectations, as well as aspects that could be improved, have been highlighted and shared with peers, employees and communities. Aspects most often cited by verifiers as positively demonstrating the ethic of Responsible Care® are those related to pollution prevention. Those identified as needing more work are often in the area of effective community dialogue.

The association is field testing a new verification process. This action will be conducted upon the third anniversary of each company's successful completion of the first verification process. It will focus on ensuring no "backsliding" has occurred, and look for documented evidence of continuous performance improvement. Another key goal is to identify and share best practices.

Responsible Care®, an ethic of the CCPA, is backed up by six codes of practice with 151 elements of sound environmental and safety management in all phases of a company's operations and products. Many C4 participants are also CCPA members. Leadership groups involving CEOs from all companies are key to the ethical focus and peer pressure support. Also critical to the growing success of Responsible Care has been the panel of community interest representatives that have met three to four times a year since 1986 to provide constructive criticism, suggestions and encouragement to the CCPA.

*This annex, prepared by the Canadian Chlorine Coordinating Committee, an alliance of seven industry associations and 23 companies, is included as an illustration of industry activities related to chlorinated substances.

Each member company of the CCPA has subscribed to the following guiding principles:

- ensure its operations do not present an unacceptable level of risk to employees, customers, the public or the environment;
- provide relevant information on the hazards of chemicals to its customers, urging them to use and dispose of products in a safe manner, and make such information available to the public on request;
- make Responsible Care® an early and integral part of the planning process leading to new products, processes or plants;
- increase the emphasis on the understanding of existing products and their uses and ensure that a high level of understanding of new products and their potential hazards is achieved prior to and throughout commercial development;
- comply with all legal requirements which affect its operations and products;
- be responsive and sensitive to legitimate community concerns; and
- work actively with and assist governments and selected organizations to foster and encourage equitable and attainable standards.

Six codes have been developed focusing on the following areas:

- community awareness and emergency response (including a policy on community right-to-know);
- research and development;
- manufacturing;
- transportation;
- distribution; and
- hazardous waste management.

As part of the Responsible Care® initiative, CCPA issues annual emission inventories. *Reducing Emissions 6*, including 1997 emissions and five-year projections, indicates that by 1997 CCPA member companies have achieved a 62 per cent reduction in total emissions of chlorinated substances from 1992 levels. Emission levels for 2002 are projected to be maintained at 1997 levels, despite an increase in production levels projected during that time period.

With respect to toxic chlorinated substances, the report records reductions of 58 per cent in chlorinated substances from CEPA Schedule 1 between 1992 and 1997. Reductions of these substances are projected to reach 61 per cent by 2002 from base year levels.

2.3 Memoranda of Understanding

Industry has made voluntary commitments to emission reduction and pollution prevention. It has confirmed these commitments through Memoranda of Understanding **(MOUs)** with federal and provincial governments. CCPA has MOUs with the governments of Canada, Quebec, B.C. and Alberta.

2.4 Environmental Management Program – Vinyl Council of Canada

The Vinyl Council of Canada launched its Environmental Management Program **(EMP)** in March 1999. The EMP consists of six Principles, five Commitment Areas and 32 Action Steps. It provides a framework to guide vinyl manufacturers in the reduction of environmental impacts throughout the life cycle of their products. It is modelled in part on the CCPA Responsible Care® program, but is focussed on the vinyl processing industry. Because of the specific management systems approach and the guidance detail, the EMP is seen as an ideal stepping stone to certification under ISO 14001, a well accepted standard for environmental management. The EMP has the support of Environment, Health and Industry Canada as well as a public advisory panel involving 11 people active in environmental and public interest groups or relevant institutions. Dialogue between these groups and the three government departments provided valuable input during the development of the EMP. Four workshops dealing with implementation of the EMP were conducted during 1999. Quarterly reporting on implementation progress, along with leadership group meetings for CEOs and coordinators, will help keep the initiative on track. Regular reviews of the EMP were conducted with the above three federal departments.

3.0 Improving Scientific Understanding

As a part of a program to increase knowledge regarding chlorine chemistry and to promote science-based decision making, C4 initiated development of a research program in 1994. A team of volunteer researchers from universities, hospitals, and government was assembled as a Science Advisory Group (SAG). This group assisted in identifying gaps in research and in establishing key research areas for the program. A research advisor was engaged and research guidelines developed. The SAG continues to meet annually to monitor progress and advise on future directions.

To date, 24 projects have been funded and $1.18 million disbursed over 4 years. Wherever possible, these funds are leveraged through joint funding with government, university, or other industrial contributors. In order to avoid duplication, the program is coordinated with the extensive programs of research funded by the Chlorine Chemistry Council in the USA and Euro Chlor in Europe. Funding of projects relative to key research areas is ongoing.

Projects have been funded in the areas of environmental fate and monitoring, environmental and human exposure and effects, chlorine disinfection-related exposure and effects, wildlife and human endocrine-related exposure and effects, probabilistic risk assessment, and risk communication and risk-based cost-benefit analysis.

4.0 Socio-Economic And Public Health Studies

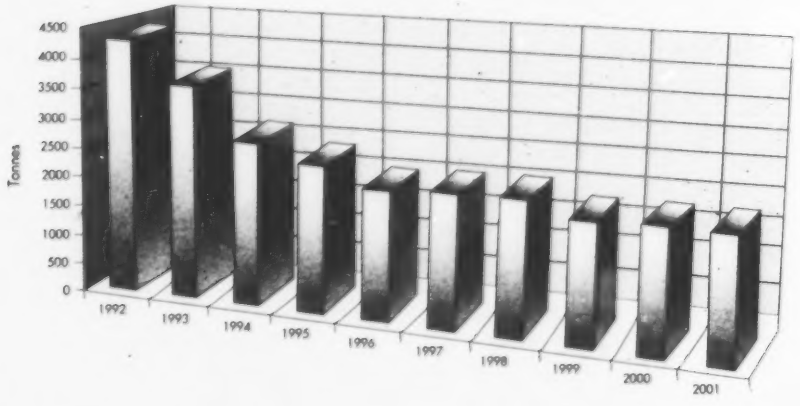
C4 has cooperated and provided input as appropriate to two completed Environment Canada Studies – *Chlorine Supply and Applications*, and *A Technical and Socio-economic Evaluation of Options to the Use of Products derived from the Chlor-Alkali Industry*.

To supplement these government funded studies, industry sponsored a study by Charles River Associates entitled *Assessment of the Economic Benefits of Chlor-Alkali Chemicals to the United States and Canadian Economies* (1993), and more recently *Assessment of the Impact on the Automotive Industry of a Potential Ban on the use of Chlorine Chemistry* (1996).

Because of the complexity of the 12,500 components, 100 sub-systems and 12 major systems in the typical automobile, the latter study focused on three materials, namely steel, polyvinyl chloride, and titanium dioxide. For the limited portion of automobiles studied, a move away from chlorine chemistry suggested an initial cost of $147.23 per vehicle or a $2.2 billion annual cost in North America, in addition to an additional 25 million pounds per year of waste to landfills.

The research program related to public health studies is covered under Section 3.0 – Improving Scientific Understanding.

Figure 1:
Total Emissions of Chlorine Compounds from CCPA Sites



Graph source: CCPA

5.0 Better Information to Canadians

C4 is committed to providing more information to Canadians to assist in better environmental decision-making.

Through its web site at http://cfour.org, C4 makes available descriptions of its research projects and summaries of progress to date on the projects, as well as a description of its other activities.

Researchers supported by the organization's research program are encouraged to publish results in the technical literature with the results available to all.

To assist municipal officials and other interested parties, C4 and the Chlorine Chemistry Council have produced a white paper entitled *The Chlorination of Drinking Water – A Review of Disinfection Practices and Issues*. This paper discusses the role of water disinfection and the merits of chlorine and alternatives for this purpose. This and other information is made available through the mail and through participation at municipal conference expositions.

Emission reporting by industry is encouraged through participation in programs such as the CCPA National Emissions Reduction Masterplan **(NERM)**, the National Pollutant Release Inventory **(NPRI)**, and the Accelerated Reduction and Elimination of Toxics **(ARET)** Program.

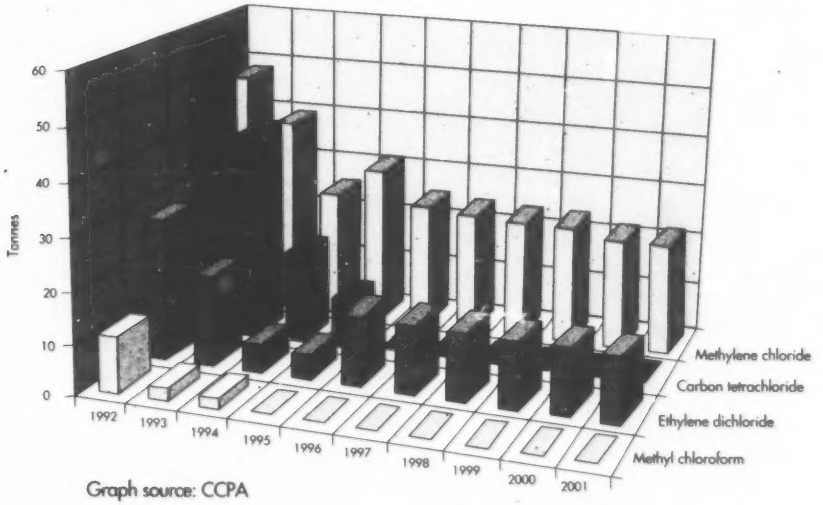
For results achieved through these programs, refer to CCPA's *Reducing Emissions 6* Report, the ARET *Environmental Leaders 3* Report, and the summary reports of the NPRI.

Figures 1 and 2, taken from NERM data, indicate emissions of chlorine based compounds from CCPA sites from 1992 to 1996, with projections to 2001. Figure 1 shows the total of chlorine based compounds, and Figure 2 shows emissions of some individual chlorinated substances.

6.0 International Action

Industry representatives support the principles and risk-based decision making approaches underlying Canada's Toxic Substances Management Policy and CSAP. They have worked cooperatively with Environment Canada to promote the Canadian approach in international negotiations and discussions. Specifically, in relation to the discussions regarding POPs, Canadian industry worked with its international counterparts in the International Council of Chemical Associations and the World Chlorine Council to support implementation of the Canadian approach to POPs in discussions at the United Nations Economic Commission for Europe (UN/ECE) and the International Forum on Chemical Safety/United Nations Environmental Program.

Figure 2:
Examples of Chlorine Compound Emissions from CCPA Sites



Graph source: CCPA

The UN-ECE has finalized protocols designed to control and reduce air emissions to the environment of 16 POPs. The protocols were signed in June 1998. This treaty covers North America and Europe, and a global agreement is currently being negotiated.

Industry also supported the Canadian policy approach that resulted in the finalization of the Great Lakes Binational Toxics Strategy in 1997. Through its membership in the Council of Great Lakes Industries, C4 is working with the two governments and other groups to inform industry and promote implementation of this agreement.

7.0 Conclusions

C4 participants continue to accept the challenge to industry based on identified areas of concern and are happy to showcase progress in these areas and their compliance with the CSAP.

The industry believes the public would be well served through greater recognition of the role of responsible initiatives such as Responsible Care®, the ARET program, and reporting mechanisms such as NERM and NPRI.

Continued support can be expected for sound policies based on good science and risk-based decision-making.